NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

AGENCY: Bureau of Ocean Energy Management
Bureau of Safety and Environmental Enforcement
National Marine Fisheries Service, Office of Protected Resources
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Environmental Protection Agency

ACTIVITY CONSIDERED: Construction, Operation, Maintenance, and Decommissioning of the Atlantic Shores South Offshore Energy Project (Lease OCS-A 0499)

GARFO-2023-01804

CONDUCTED BY: National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

DATE ISSUED: December 18, 2023

APPROVED BY: ______________________________
Michael Pentony
Regional Administrator

Table of Contents

1.0 INTRODUCTION

This constitutes NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Opinion) issued to the Bureau of Ocean Energy Management (BOEM), as the lead federal agency, in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended, on the effects of its proposed approval, with conditions, of the Construction and Operation Plan (COP) authorizing the construction, operation, maintenance, and decommissioning of the Atlantic Shores South Offshore Wind Project under the Outer Continental Shelf Lands Act (OCSLA). The applicant and lessee, Atlantic Shores Offshore Wind LLC, is proposing to construct, operate, and eventually decommission two commercial-scale offshore wind energy facilities (Atlantic Shores 1 and Atlantic Shores 2) within Lease Area OCS-A 0499 that would consist of up to 200 wind turbine generators, up to 10 offshore substations (OSS), one meteorological tower, and associated inter-array cabling as well as export cabling to bring electricity to land.

BOEM is the lead federal agency for purposes of section 7 consultation; the other action agencies are the Bureau of Safety and Environmental Enforcement (BSEE), the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard (USCG), the U.S. Environmental Protection Agency (EPA), and NMFS Office of Protected Resources[1], each of whom is taking action under their respective statutory and regulatory authorities related to approval of the COP and its conditions and therefore have corresponding ESA section 7 consultation responsibilities. This Opinion considers effects of the proposed federal actions (collectively referred to in this opinion as the proposed action) on ESA-listed whales, sea turtles, fish, and designated critical habitat that occur in the action area (as defined in section 3.0 of this Opinion). A complete administrative record of this consultation will be kept on file at our Greater Atlantic Regional Fisheries Office.

1.1 Regulatory Authorities

The Energy Policy Act of 2005 (EPAct), Public Law 109-58, added section 8(p)(1)(c) to the Outer Continental Shelf Lands Act. This authorized the Secretary of Interior to issue leases, easements, and rights-of-way (ROW) in the Outer Continental Shelf (OCS) for renewable energy development, including wind energy. The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing this authority (30 CFR part 585) were promulgated on April 22, 2009 and amended in 2023. These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove a lessee's Construction and Operations Plan (COP). Atlantic Shores, a lessee, filed their COP with BOEM on March 26, 2021, with subsequent updates in December 2021, and May 2023[2]. BOEM issued a Notice of Intent to prepare an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) (42 USC § 4321 et seq.) on September 30, 2021, to assess the potential biological and physical environmental

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[1] The NMFS Office of Protected Resources (OPR), located in NMFS' Silver Spring, MD, Headquarters (HQ) Office, is proposing to issue an Incidental Take Authorization under the MMPA and is thus an action agency responsible for consulting under Section 7 of the ESA, whereas NMFS's Gloucester, MA, Greater Atlantic Regional Fisheries Office (GAR) is the consulting agency, under ESA regulations at 50 C.F.R. part 402.

[2] The May 2023 COP and appendices are available online at: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-south

impacts of the Proposed Action and Alternatives (88 FR 54231) on the human environment. A draft EIS (DEIS) was published on May 19, 2023.[3]

BSEE's mission is to enforce safety, environmental, and conservation compliance with any associated legal and regulatory requirements during project construction and future operations. BSEE will be in charge of the review of Facility Design and Fabrication and Installation Reports, oversee inspections/enforcement actions as appropriate, oversee closeout verification efforts, oversee facility removal inspections/monitoring, and oversee bottom clearance confirmation. BSEE's approvals and activities are included as elements of the proposed action in this opinion.

EPA anticipates proposing to issue an OCS Air Permit to Atlantic Shores. Atlantic Shores submitted an application to EPA for the OCS Air Permit on September 1, 2022. The EPA received additional information from Atlantic Shores on June 30, 2023; the OCS Air Permit application has not yet been deemed complete. This permit will be issued pursuant to the provisions of Section 328 of the Clean Air Act (CAA) and the Code of Federal Regulations (C.F.R.) Title 40, Part 55, and will be effective until surrendered. EPA anticipates including emission limits, operating requirements and work practices, and testing, recordkeeping, and reporting requirements. Anticipated air emission sources are the marine vessels to be used to support construction and operation/maintenance, and any generators or other emission sources at the WTGs and offshore substation. EPA's OCS Air permit is included as an element of the proposed action in this opinion.

USACE issued a Public Notice (NAP-2017-01069-84[4]) describing its consideration of Atlantic Shores' request for a permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344) on May 19, 2023. As described in the Public Notice, the applicant proposes to install and maintain two offshore wind energy facilities and the required supporting infrastructure. The Projects include up to 200 wind turbine generators (WTGs), up to ten offshore substations, one permanent meteorological tower, up to four temporary meteorological towers, array cables linking the individual turbines to the offshore substation(s), substation interconnector cables linking offshore substations to each other, offshore export cables, an onshore export cable system which includes underground cables, at least two onshore substations, and connections to the existing electrical grid in New Jersey. USACE's permit is included as an element of the proposed action in this opinion. Atlantic Shores is also applying for authorization from USACE to carry out repairs and rehabilitation to support an Operations and Maintenance facility in Atlantic City, NJ. This activity has been identified by BOEM as a Connected Action and is addressed in this Opinion.

The USCG administers the permits for private aids to navigation (PATON) located on structures positioned in or near navigable waters of the United States. PATONS and federal aids to

[3] The DEIS is available online at: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-south-draft-environmental-impact

[4]Public Notice is online at https://www.nap.usace.army.mil/Portals/39/docs/regulatory/publicnotices/Public%20Notice-2019-01069-84.pdf

navigation (ATONS), including radar transponders, lights, sound signals, buoys, and lighthouses are located throughout the Project area. It is anticipated that USCG approval of additional PATONs during construction of the WTGs, OSSs, and along the offshore export cable corridor may be required. These aids serve as a visual reference to support safe maritime navigation. Federal regulations governing PATON are found within 33 CFR part 66 and address the basic requirements and responsibilities. USCG's proposal to permit installation of additional aids to navigation are included as elements of the proposed action in this opinion.

The Marine Mammal Protection Act of 1972 (MMPA) as amended, and its implementing regulations (50 CFR part 216) allow, upon request, the incidental take of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region assuming certain statutory and regulatory findings are made. To "take" is defined under the MMPA (50 CFR§ 216.3) as,

> to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: The collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild.

"Incidental taking" means "an accidental taking. This does not mean that the taking is unexpected, but rather it includes those takings that are infrequent, unavoidable, or accidental." (50 C.F.R. §216.103). NMFS Office of Protected Resources (OPR) has received a request for Incidental Take Regulations (ITR) and associated Letter of Authorization (LOA) from Atlantic Shores Offshore Wind, LLC, a joint venture between EDF-RE Offshore Development LLC and Shell New Energies US LLC for the incidental take of small numbers of marine mammals during the construction of the Atlantic Shores South project.[5] The requested ITR would govern the authorization of take, by both Level A and Level B harassment[6], of "small numbers" of marine mammals over a 5-year period incidental to construction-related pile driving activities (impact and vibratory), and high-resolution geophysical (HRG) site characterization surveys. A final ITR would allow for the issuance of a LOA to Atlantic Shores for a 5-year period; the issuance of two LOAs (one for Project 1 and one for Project 2) is proposed. NMFS OPR's issuance of an ITR and LOAs is included as an element of the proposed action in this opinion.

Atlantic Shores may choose to obtain a Letter of Acknowledgment from NMFS for certain fisheries survey activities. A Letter of Acknowledgement acknowledges, but does not authorize,

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[5] Application, Notice of Receipt of Application, Proposed Rule, and Supporting Materials are available online at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-atlantic-shores-offshore-wind-llc-construction-atlantic-shores

[6] Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. 50 CFR §216.3

certain activities as scientific research conducted from a scientific research vessel. (See 50 CFR §600.745(a)). Scientific research activities are activities that would meet the definition of fishing under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), but for the statutory exemption provided for scientific research. (16 USC § 1802(16)). Such activities are statutorily exempt from any and all regulations promulgated under the Magnuson-Stevens Act, provided they continue to meet the definition of scientific research activities conducted from a scientific research vessel. To meet the definition of a scientific research vessel, the vessel must be conducting a scientific research activity and be under the direction of one of the following: Foreign government agency; U.S. Government agency; U.S. state or territorial agency; University (or other educational institution accredited by a recognized national or international accreditation body); International treaty organization; or, Scientific institution. In order to meet this definition, vessel activity must be dedicated to the scientific research activity, and cannot include commercial fishing. Scientific research activity, for Magnuson-Stevens Act purposes, includes, but is not limited to, sampling, collecting, observing, or surveying the fish or fishery resources within the Exclusive Economic Zone. Research topics include taxonomy, biology, physiology, behavior, disease, aging, growth, mortality, migration, recruitment, distribution, abundance, ecology, stock structure, bycatch or other collateral effects of fishing, conservation engineering, and catch estimation of fish species considered to be a component of the fishery resources. The issuance of a Magnuson-Stevens Act related Letter of Acknowledgment by NMFS is not a federal action subject to section 7 consultation, and it is not an authorization or permit to carry out an activity and the issuance of LOA's, should they be requested, is not considered an element of the proposed action in this opinion. However, BOEM's proposed action we are consulting on includes surveys that may be carried out with a Magnuson-Stevens Act Letter of Acknowledgement. These surveys and their effects would not occur but for the Atlantic Shores South project proposed in the Construction and Operation Plan upon which BOEM intends to act under OCSLA, and it is, thus appropriate to consider them in this Opinion as consequences of BOEM's proposed action and, to the extent the surveys may cause effects to listed species at a level resulting in the incidental take of ESA-listed species, address such take in this Opinion's Incidental Take Statement.

2.0 CONSULTATION HISTORY AND APPROACH TO THE ASSESSMENT

As explained above, BOEM is the lead federal agency for this section 7 consultation. BOEM submitted a draft Biological Assessment (BA) to NMFS GARFO on August 2, 2022. We requested additional information from BOEM in correspondence dated October 3, 2022. BOEM submitted a revised BA and request for consultation to NMFS GARFO on May 22, 2023, as the lead federal agency for the ESA consultation and on behalf of BSEE, USACE, EPA, and the USCG; this BA also acknowledged NMFS OPR's anticipated issuance of a proposed MMPA ITA. On June 20, 2023, we sent an email to BOEM identifying information that was missing from the BA that was necessary to initiate consultation. We received a revised BA on July 13, 2023.

On July 19, 2023, we received a draft *Notice of Proposed Incidental Take Regulations for the Taking of Marine Mammals Incidental to the Atlantic Shores South Offshore Wind Project*, from our Office of Protected Resources (OPR) and an accompanying request for initiation of ESA section 7 consultation. On September 22, 2023, OPR submitted the published proposed rule (88 FR 65430, referred to herein as the proposed MMPA ITA).

On July 19, 2023, we deemed the information submitted by BOEM and NMFS OPR sufficient to assess the effects of the proposed action on ESA-listed species and designated critical habitat and that the information constituted the best scientific and commercial data available (50 CFR §402.14(c)(-(d)); ESA formal section 7 consultation was initiated on that date. To harmonize various regulatory reviews, increase certainty among developers regarding anticipated regulatory timelines, and allow sufficient time for NMFS' production of a final biological opinion, BOEM and NMFS have agreed to a standardized ESA Section 7 consultation timeline under the offshore wind program that allocates 150 days for consultation and production of a biological opinion for each proposed offshore wind project, unless extended. In this case, the identified deadline for issuance of the Opinion is December 18, 2023.

Consideration of Activities Addressed in Other ESA Section 7 Consultations
As described in section 3 below, some Atlantic Shores project vessels will utilize the Paulsboro Marine Terminal in Paulsboro, NJ, the Repauno Port and Rail Terminal (also known as the DRP Gibbstown Shipping Terminal and Logistic Center), and the New Jersey Wind Port in Lower Alloways, NJ. NMFS GARFO has completed ESA section 7 consultation with the USACE for the construction and operation of each of these port facilities. The Biological Opinions prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023[7], "2023 Paulsboro Opinion"), New Jersey Wind Port (February 25, 2022, "2022 NJWP Opinion"), and the Repauno/Gibbstown Shipping Terminal (December 8, 2017, "2017 Repauno Opinion") considered effects of construction activities as well as effects of all vessels transiting to/from these ports (to/from the mouth of Delaware Bay), on ESA listed species and critical habitat designated for the New York Bight distinct population segment (DPS) of Atlantic sturgeon.

Each of these three Biological Opinions analyzed an overall amount of vessel transits, of which Atlantic Shores would contribute a small part. The effects analyzed in the three completed port Opinions will be considered as part of the *Environmental Baseline* of this Opinion, given the definition of that term at 50 CFR §402.02. The effects specific to Atlantic Shores' vessel use of those ports will be discussed in the *Effects of the Action* section by referencing the analysis in three port Opinions and determining whether the effects of Atlantic Shores' vessels transiting to and from those ports are consistent with those analyses or anticipated to cause additional effects. In the *Integration and Synthesis* section, if we determine any additional effects of Atlantic Shores' vessels will be caused by the proposed action we will evaluate them in addition to the effects included in the *Environmental Baseline*, which already includes the effects of vessel transits analyzed in the three port Biological Opinions. In these sections we address new information on the risk of vessel strike for Atlantic sturgeon in the Delaware River that has become available since the 2017 Repauno Opinion was completed.

By using this approach, this Opinion ensures that all of the effects of Atlantic Shores' vessel transits to and from the ports analyzed in other Biological Opinions will be considered in the *Integration and Synthesis* section and reflected in this Opinion's final determination under ESA 7(a)(2). This methodology also ensures this Opinion does not "double-count" effects of Atlantic Shores' vessel transits to and from the ports–once in the *Environmental Baseline* and once in the

[7] The November 2023 Opinion is the result of reinitiation of ESA section 7 consultation and replaces the July 19, 2022 Opinion issued to the USACE.

Effects of the Action section. Any incidental take anticipated by Atlantic Shores' vessel transits, even if already specified and exempted in the port Biological Opinions' Incidental Take Statements, will also be specified in this Opinion's Incidental Take Statement and will be subject to the relevant reasonable and prudent measures and terms and conditions from the port Opinions[8]. This approach is being taken because BOEM was not a party to the three port Biological Opinions, yet Atlantic Shores' vessel transits would not occur but for BOEM's COP approval. Therefore, it is reasonable, necessary, and appropriate to specify this incidental take, as well as any non-discretionary measures to minimize, monitor, and report such take, in this Opinion's Incidental Take Statement (ITS) that will apply to the relevant action agencies identified in this Opinion and its ITS.

Connected Action - Atlantic City O&M Facility

The developer is proposing to establish an O&M facility in Atlantic City Harbor for the Atlantic Shores South project. To support construction of the proposed O&M facility in Atlantic City, bulkhead repair and/or replacement, and maintenance dredging will be carried out within Atlantic City's Inlet Marina area. BOEM determined that the bulkhead repair/replacement and dredging activities are considered to be a Connected Action under NEPA and includes these as part of the proposed action in the BA; the effects of this activity are addressed in section 7 of this Opinion. Consultation has already been carried out between NMFS and the USACE for some of these activities. Maintenance dredging will be carried out under the terms of a permit issued by the USACE (NAP-2021-00573-95); NMFS completed informal ESA section 7 consultation on the activities authorized by this permit by concurring with the USACE's determination that the proposed activities were "not likely to adversely affect" any ESA listed species on January 27, 2022. The dredging activities as described by BOEM in the Atlantic Shores BA are consistent with the activities considered in this informal consultation and are identified in the Environmental Baseline of this Opinion. The assessments and conclusions are incorporated by reference into this Opinion. As no other consultation has been completed to date for the proposed bulkhead repair/replacement activities, the effects of those activities are considered consequences of the proposed action and are addressed in this Opinion.

Consideration of the 2019 ESA Regulations

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in this biological opinion

[8] While the 2017 Repauno Opinion estimated the amount of take of shortnose and Atlantic sturgeon anticipated to result from use of the terminal, the Opinion did not include an Incidental Take Statement that exempted take from the section 9 prohibitions on take; no Reasonable and Prudent Measures or implementing Terms and Conditions were included in that Opinion.

and its incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

3.0 DESCRIPTION OF THE PROPOSED ACTIONS ON WHICH CONSULTATION WAS REQUESTED

In this section and throughout the Opinion we use a number of different terms to describe different geographic areas of interest. For clarity, we define those terms here. Wind Development Area (WDA) is the area consisting of the location of the wind turbine generators, offshore substations, interarray cables, and the cable corridors between the offshore lease area and the two landfall sites in New Jersey. The Wind Farm Area (WFA) is a subset of the WDA and is that portion of Atlantic Shore's lease (OCS-A 0499) where the wind turbine generators and OSSs will be installed and operated (i.e., the offshore portion of the WDA minus the cable routes to shore); considered together, the Project 1 and Project 2 WFAs are nearly co-extensive with the lease area and we may use the terms Atlantic Shores WFA and lease area interchangeably in the Opinion. The action area is defined in section 3.10 below and includes the WDA (and WFA) as well as the portion of the U.S. EEZ used by project vessels transiting from ports along the U.S. Atlantic Coast and in the Gulf of Mexico that were identified in BOEM's BA, inclusive of the transit routes to/from the identified ports in the Delaware River. Note that references to "the project" are generally inclusive of Project 1 and Project 2.

3.1 Overview of Proposed Federal Actions

BOEM is the lead federal agency for the project for purposes of this ESA consultation. The proposed action described in the BA consists of the proposed approvals, permits, and authorizations for two wind energy facilities referred to as Atlantic Shores South Project 1 and Atlantic Shores South Project 2 located in Lease Area OCS-A 0499 off the coast of New Jersey. BOEM has identified the construction of an O&M facility in Atlantic City, New Jersey as a "connected action" under NEPA. As explained above, ESA section 7 consultation has already been completed between USACE and NMFS on the maintenance dredging identified as part of the connected action and that portion of the activity is therefore included in the *Environmental Baseline* while consultation on other parts of the connected action (bulkhead repairs/replacement) is considered in the *Effects of the Action* section of this Opinion. A brief summary of the activities proposed for the connected action is provided below.

In addition to BOEM's proposed approval of Atlantic Shore's Construction and Operations Plan (COP), BOEM's May 2023 request for consultation also addressed: EPA's proposal to issue an Outer Continental Shelf Air Permit; the USACE's proposal to issue a permit for in-water work, structures, and fill under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act; and the USCG proposal to issue a Private Aids to Navigation (PATON) Authorization. BOEM also identified the role of the Bureau of Safety and Environmental Enforcement (BSEE) in taking actions related to the project and NMFS OPR's proposal to issue a Marine Mammal Protection Act (MMPA) Incidental Take Authorization (ITA) in their request for consultation and NMFS OPR submitted a separate request for consultation on July 19, 2023.

The reorganization of the Renewable Energy rules [30 CFR Parts 285, 585, and 586] enacted on January 31, 2023) reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to Bureau of Safety and

Environmental Enforcement (BSEE). BSEE is responsible for enforcing safety, environmental, and conservation compliance with any associated legal and regulatory requirements during project construction and future operations. Additionally, BSEE will: oversee operations, inspections, and enforcement actions; oversee closeout verification efforts; decommissioning activities including facility removal and inspections/monitoring; bottom clearance confirmation and provide analysis of the Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and other project-related plans for operations, safety, and environmental protection. A lessee may not commence fabrication or installation of facilities until the lessee resolves all objections to the FDR or FIR to BSEE's satisfaction, if BSEE communicates objections. 30 CFR 285.700(a)-(c).

BOEM indicated it will require, through COP approval, all Project construction vessels to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR §151.2025) and EPA National Pollutant Discharge Elimination System Vessel General Permit standards.

The information presented here reflects the proposed action and effects described by BOEM in their July 13, 2023, Biological Assessment, additional information received through the consultation period, and the proposed Marine Mammal Protection Act Incidental Take Authorization (88 *Federal Register* 65430; September 22, 2023). As noted, all the foregoing Federal permits, authorizations, and approvals collectively constitute the proposed action for consultation in this opinion. Accordingly, for simplicity, we may refer to the proposed action as BOEM's authorization or proposal when that authorization or proposal may also include other Federal actions (e.g., construction, operation, and decommissioning of the wind turbines requires permits, authorizations or approvals from BOEM, BSEE, USACE, EPA, USCG, and NMFS OPR).

The proposed action described in the BA and analyzed in this Opinion consists of Atlantic Shores Project 1 and Atlantic Shores Project 2. Project 1 will be developed under a 1,510 MW Offshore Renewable Energy Credit (OREC) awarded to Atlantic Shores by the New Jersey Board of Public Utilities (NJBPU) on June 30, 2021. Project 2 will be developed to support future OREC solicitations issued by NJBPU. The Atlantic Shores Project includes a maximum of 200 WTGs (105 to 136 for Project 1, 64 to 95 for Project 2)[9], up to 10 OSSs (up to five each for Project 1 and Project 2), 1 met tower, four temporary meteorological and oceanographic (metocean) buoys (three for Project 1 and one for Project 2), 584 miles (940 km) of inter-array cables, 37 miles (60 km) of interlink cables, and 441 miles (550 km) of export cables. Planned export cable landfalls are the Monmouth landfall in Sea Girt, New Jersey, and the Atlantic landfall in Atlantic City, New Jersey. All WTGs for Project 1 will be placed on 12-m or 15-m diameter monopile foundations; all WTGs for Project 2 will be placed on monopiles (scenario 1) or pile jacket foundations (scenario 2). A number of foundation types are proposed for the up to 10 OSSs and the single met tower (see Table 3.1). Installation of foundations is expected to occur over two construction seasons. Atlantic Shores would also install and remove, by vibratory pile driving, up to eight temporary nearshore cofferdams to support connection of the offshore export cables to onshore facilities. All offshore cables would be connected to onshore

[9] While a specific nameplate capacity is not identified in the COP, the MMPA Proposed Rule identifies an "up to 15 MW" capacity for the WTGs (88 FR 65430)

export cables at the sea-to-shore transition points located in Atlantic City, New Jersey and in Sea Girt, New Jersey. From the sea-to-shore transition point, onshore underground export cables are then connected in series to switching stations/substations, overhead transmission lines, and ultimately to the grid connection. The Lease Area (OCS-A 0499) is located in federal waters on the OCS; the proposed location of major project components are shown in Figure 3.1.

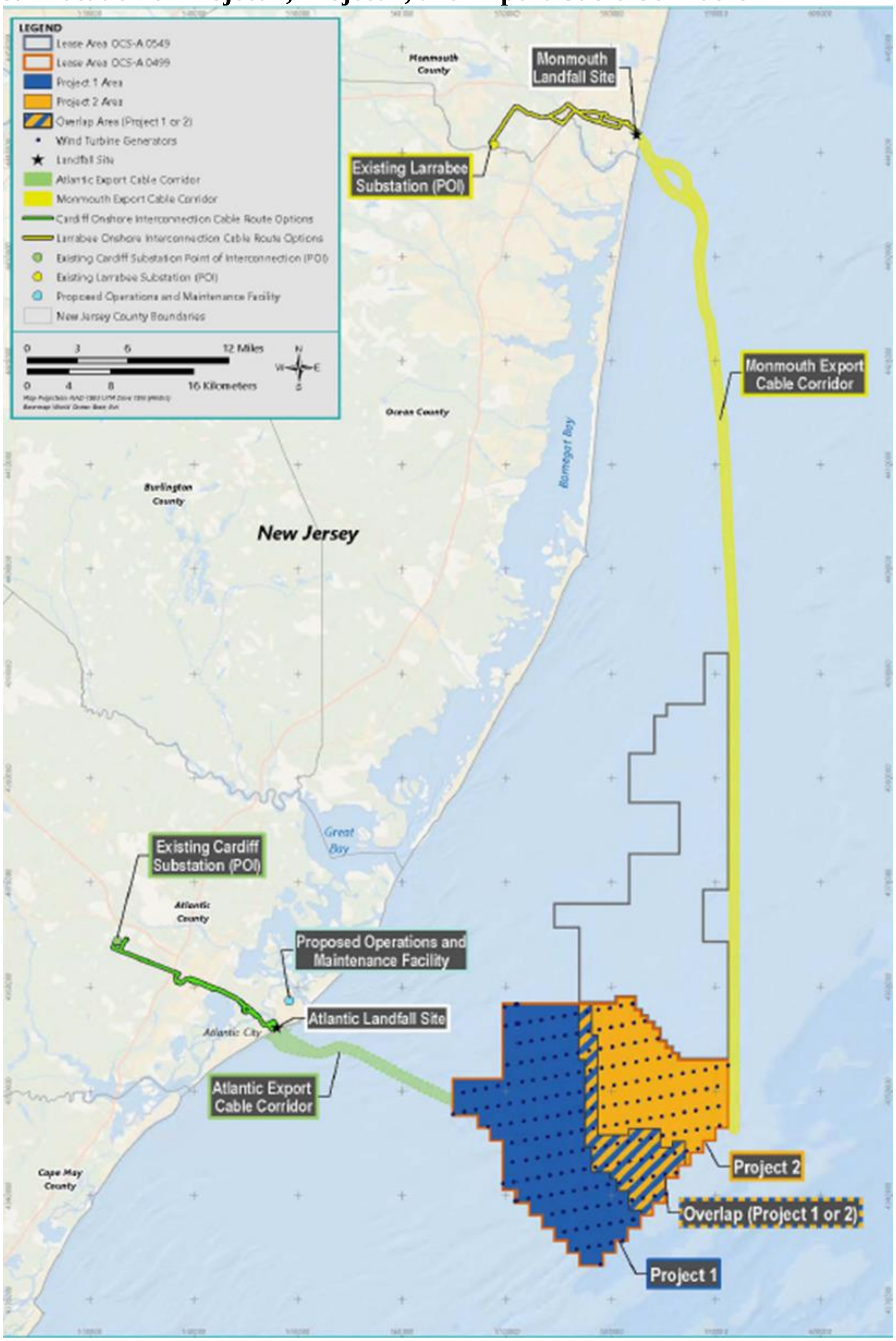
The project also includes a number of surveys including high-resolution geophysical surveys (HRG), and biological and benthic monitoring. Deployment of other data collection equipment such as meteorological/weather buoys, and passive acoustic detection devices to monitor for marine species vocalizations or sonic tags may be deployed intermittently over the duration of the project. These data collection activities will occur during the pre-construction, construction, and operation and maintenance phases of the project.

Table 3.1 Foundation Types for Scenario 1 and Scenario 2

	Project 1		**Project 2**	
Structure	**Number**	**Foundation Type**	**Number**	**Foundation Type**
SCENARIO 1				
WTG	105 to 136	Monopile	64 to 95	Monopile
OSS	2 to 5 (2 large, 2 medium or 5 small)	Small OSS: Monopile, piled jacket, or suction bucket jacket	2 to 5 (2 large, 3 medium or 5 small)	Small OSS: Monopile, piled jacket, or suction bucket jacket
		Medium or large OSS: Piled jacket, suction bucket jacket, or gravity-based structure		Medium or large OSS: Piled jacket, suction bucket jacket, or gravity-based structure
Met tower	1	Monopile, piled jacket, suction bucket jacket, mono-bucket, or gravity-based structure	0	--
SCENARIO 2				
WTG	105 to 136	Monopile	64 to 95	Piled Jacket
OSS	2 to 5 (2 large, 2 medium or 5 small)	Small OSS: Monopile, piled jacket, or suction bucket jacket	2 to 5 (2 large, 3 medium or 5 small)	Small OSS: Monopile, piled jacket, or suction bucket jacket
		Medium or large OSS: Piled jacket, suction bucket jacket, or gravity-based structure		Medium or large OSS: Piled jacket, suction bucket jacket, or gravity-based structure
Met tower	1	Monopile, piled jacket, suction bucket jacket, mono-bucket, or gravity-based structure	0	--

source: Table 1-2 in BOEM’s BA

Figure 3.1 Location of Project 1, Project 2, and Export Cable Corridors



(Source: Figure 1-1 in BOEM's BA)

3.2 Connected Action – Atlantic Shores O&M Facility at Atlantic City

The proposed action described in BOEM's BA includes a new O&M facility in Atlantic City established by Atlantic Shores to host its O&M personnel, dock vessels, and store equipment, tools, spare parts, and consumables. To establish the O&M facility, Atlantic Shores intends to develop a shoreside parcel in Atlantic City that was formerly used for vessel docking or other port activities. Construction of the O&M facility is expected to involve the construction of a new building and associated parking structure, repairs to the existing bulkheads/docks, installation of new dock facilities, and maintenance dredging in coordination with the City's dredging of the adjacent basins. Atlantic Shores will complete maintenance dredging for the O&M facility under an existing Nationwide Permit #3 as approved by USACE (CENAP-OPR-2021- 0573-95) and NJDEP Dredge Permit No. 0102-20-0001.1 LUP 210001 and issued to the Atlantic City municipal government. As explained above, consultation has been completed between USACE and NMFS on the issuance of the referenced permit.

In the COP, Atlantic Shores notes that the repair activities for the bulkheads will be permitted separately through USACE by Atlantic Shores under an Individual Permit pursuant to Sections 10 and 404 of the Rivers and Harbors Act and Clean Water Act. However, in the BA, BOEM indicates that Atlantic Shores is pursuing authorization under USACE Nationwide Permit 3/Nationwide Permit 13 for the proposed work. As the BA post-dates the COP and was reviewed by the USACE, we consider the description of the proposed permitting in the BA to be the best available information on the proposed action. The proposed work includes installation of an approximately 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles and would comply with the relevant project design criteria of the relevant programmatic ESA consultation. Regardless of whether an individual or nationwide permit is pursued for authorization, as noted in the BA, the proposed activities are expected to fall within the scope of the April 2017 programmatic ESA consultation completed between NMFS and USACE. However, as USACE has not yet submitted a verification request to NMFS GARFO, we will consider the effects of the sheet pile installation work, including the effects of relevant project design criteria, in this Opinion as effects of the proposed action (i.e., independent of the 2017 programmatic ESA consultation).

As described in the BA, the existing bulkhead at the site of the proposed O&M facility is approximately 250 feet (76 meters) long and composed of multiple sections that are made from steel sheet piles, timbers, and concrete. The existing bulkhead is missing sections, making it unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead is necessary to stabilize the shoreline and prevent additional erosion. To repair/replace the existing bulkhead, Atlantic Shores plans to install an approximately 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles. The new bulkhead will be sited externally of the existing bulkhead, as the existing bulkhead will remain in place, unless removal of specific sections is required to safely install the new bulkhead. It is anticipated that the new bulkhead will be supported by anchor piles. All pile installation will be completed with a vibratory hammer. No other in-water work was described in the BA.

3.3 Construction of the Atlantic Shores South Project

Offshore construction includes installation of WTGs, OSSs, and a met tower, and installation of inter-array, interlink, and export cables. The general construction schedule, assuming a 2024 start for onshore activities, is described in the table below.

Table 3.2. Anticipated Construction Schedule for the Proposed Action

Activity	Expected Duration[1]	Expected Time Frame[2]	Anticipated Start Date	
			Project 1	Project 2
Onshore interconnection cable installation	9-12 months	2024 – 2025	Q1 2024	Q1 2024
Onshore substation and/or converter station construction	18-24 months	2024 – 2026	Q1 2025	Q1 2025
HRG survey activities	12 months	2025 – 2029	Q2 2025	Q2 2025
Export cable installation	6-9 months	2025	Q2 2025	Q3 2025
Cofferdam installation and removal	3 months	2025 – 2026	Q1 2025	Q1 2025
OSS installation and commissioning	5-7 months	2025 – 2026	Q2 2026	Q2 2026
WTG foundation installation	10 months	2026 – 2027	Q1 2026	Q1 2026[3]
Inter-array cable installation	14 months	2026 – 2027	Q2 2026	Q3 2026[4]
WTG installation and commissioning	17 months	2026 – 2027	Q2 2026	Q1 2027[4]

[1] These durations assume continuous foundation installation without consideration for seasonal pauses or weather delays; anticipated seasonal pauses are reflected in the expected timeframe.
[2] The expected timeframe is indicative of the most probable duration for each activity; the timeframe could shift and/or extend depending on the start of fabrication, and the selected fabrication and installation methods.
[3] The expected timeframe depends on the foundation type. If piled foundations are utilized, pile-driving will follow a proposed schedule from May to December to minimize risk to North Atlantic Right Whale. No simultaneous/concurrent pile driving is proposed.
[4] The expected timeframe is dependent on the completion of the preceding Project 1 activities (i.e., Project 1 inter-array cable installation and WTG installation) and the Project 2 foundation installation schedule.
(Source: Table 1-4 in BOEM's BA)

3.3.1 Sea Floor Preparations

In the BA, BOEM describes that seabed preparation may be necessary in some locations prior to foundation installation. In the COP, Atlantic Shores indicates that foundations will be microsited to avoid or minimize the need for seabed preparation, where possible. As described in Section 4.2.4 of the COP, seabed preparation involves removing the uppermost sediment layer to establish a level surface, remove any surficial sediments that are too weak to support the planned structure, and enable full contact between the foundation's base and the seafloor. Seabed preparation would be accomplished using jetting/controlled flow excavation or backhoe/dipper. We note that while hopper dredging is included in the COP, BOEM confirmed during the consultation period that hopper dredging is not currently planned; as such, it is not addressed in this consultation. Seabed preparation is not generally anticipated for piled or suction bucket foundations but may be required where the seabed is not sufficiently level. Seabed preparation is anticipated for any gravity foundations to ensure full contact between the foundation's base and the seafloor so that the foundation remains vertical, and its weight is uniformly distributed. For gravity foundations, seabed preparation would be followed by the installation of a gravel pad.

Gravel pads are composed of at least one layer of coarse-grained material and may include a lower filter layer of finer material and an upper armor layer of coarser material. Gravel pad installation is expected to include: lowering of steel frame to set the boundaries for the pad; leveling the surface within the frame; filling the frame with coarse-grained material; leveling the pad; and compacting the pad, possibly injecting the pad with grout.

The maximum extent of seabed preparation described in the BA, which assumes that all foundations require seabed preparation, is provided in Tables 3.3 and 3.4; we note that only up to 6 of the foundations may be gravity foundations, thus, as sea bed preparation may not be necessary for all other foundations, therefore there is uncertainty over the precise extent of seabed preparation activity and this is considered the reasonably predictable maximum extent. In the maximum impact scenario described in the BA, up to approximately 1.1 million cubic yards of material will be removed or relocated for seabed preparation.

Table 3.3 Maximum Extent (Acres) of Seabed Preparation under Scenario 1 or Scenario 2

Structure	Scenario 1	Scenario 2
WTGs	332.23	303.44
OSSs[1]	33.94	33.94
Met Tower[2]	2.57	2.57
Total	368.75	339.95

[1] Maximum seabed preparation would result from the installation of four large OSSs with suction bucket jacket foundations
[2] Maximum seabed preparation would result from the installation of a suction bucket jacket foundation
source: Table 1-5 in BOEM's BA

Table 3.4. Maximum Extent (Acres) of Dredging under Scenario 1 or Scenario 2 of the Proposed Action

Activity	Scenario 1	Scenario 2
Seabed Preparation	368.75	339.95

[1] Maximum seabed preparation would result from the installation of four large OSSs with suction bucket jacket foundations and a met tower with a suction bucket jacket foundation
source: Table 1-6 in BOEM's BA

3.3.2 Foundation Installation – WTGs, OSSs, and Met Tower

Foundations will be installed following completion of the seafloor preparation. Together, Project 1 and Project 2 will include the installation of up to 200 WTGs (105-136 for Project 1, 64-95 for Project 2), 1 met tower, and up to 10 OSSs. Each WTG would extend up to 1,048.8 feet (319.7 meters) above mean lower low water. Minimum spacing between the WTGs would be 0.6 nautical miles (1.1 km) north to south and 1 nautical mile (1.9 km) east-northeast to west-southwest. No foundation pile driving would occur from January 1-April 30. Foundation installation is expected to occur over two construction seasons.

As noted above, a variety of foundation types are proposed (see Table 3.1). For Project 1, all WTGs will be placed on monopile foundations. For Project 2, all WTGs will be placed on monopile or jacket (pin pile) foundations. The single met tower will be installed on a monopile, jacket, suction bucket jacket, mono suction bucket, or gravity base structure foundation. Up to 10 OSSs will be installed across the two projects (up to 4 large or up to 5 medium, or up to 10 small); medium and large OSSs will be placed on pile jacket, suction bucket jacket, or gravity base structure foundations while small OSSs will be placed on monopile, pile jacket, or suction bucket foundations.

The WTGs would consist of three components: a three-bladed rotor nacelle assembly, the tower, and the foundation. The rotor would drive a variable speed electric generator. The maximum rotor diameter for the Project would be 918.6 feet (280 meters). Integrated sensors on the WTG would detect the wind direction, and the WTG would automatically turn into the wind with a yaw system, housed in the nacelle, along with the drivetrain, electric generator, control system, and power electronics. The rotor nacelle assembly would be located at the top of the tower, a steel tubular structure that supports the assembly and provides the height required to efficiently capture wind energy. The tower may house the power converter and transformer, though these pieces of equipment may also be housed within the nacelle. The tower may also contain the switchgear and inter-array cable terminations, though these pieces of equipment may also be located within the top of the foundation, which would be connected to the tower. Each WTG would contain oils, greases, and fuels used for lubrication, cooling, and hydraulic transmission. Each WTG would also include a Supervisory Control and Data Acquisition (SCADA) system, to allow for remote control and monitoring. Additionally, WTGs would include marking and lighting in accordance with USCG, Federal Aviation Administration (FAA), and BOEM guidelines and regulations. Atlantic Shores would utilize an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval, to minimize light emissions when aircraft are not in the area.

Piled foundations (i.e., monopiles and piled jackets) would be driven into the seabed. Monopiles consist of a single vertical, hollow steel pile which may be connected to a transition piece that attaches the WTG tower to the monopile above the water line or may directly interface with the WTG tower. Monopiles may also be used for small OSS foundations and the met tower. The maximum monopile diameter for the Project would be 49.2 feet (15 meters). Piled jacket foundations are vertical steel lattice structures with three or four legs connected by cross bracing. Each leg is secured to the seabed using piles. Each WTG piled jacket foundation, small OSS piled jacket foundation, or met tower foundation is expected to have up to four legs with one 16.4-foot (5-meter) diameter pile per leg. Each medium OSS piled jacket foundation is expected to have up to six legs with up to two 16.4-foot (5-meter) diameter piles per leg. Each large OSS piled jacket foundation is expected to have up to eight legs with up to three 16.4-foot (5-meter) diameter pin piles per leg, totaling 24 pin piles per foundation. For Scenario 1, 200 to 211 monopile foundations (maximum of 200 WTGs, 10 small OSSs, 1 met tower) would be installed. For Scenario 2, 136 to 147 monopile foundations (maximum of 136 WTGs, 10 small OSSs, and 1 met tower) and 95 to 106 jacket foundations (95 WTGs, 10 small OSSs, and 1 met tower) with a maximum of 480 pin piles (96 WTG and met tower foundation with 4 pin piles each and 4 large OSS foundations with 24 pin piles each) would be installed.

Piled foundations would be installed using a hydraulic impact hammer deployed on a jack-up or heavy lift vessel using dynamic positioning or anchoring. The impact hammer utilized for installation of monopile foundations would have a maximum rated capacity of 4,400 kilojoules and would drive the monopiles up to 262.5 feet (80 meters) into the seabed. Up to two monopiles could be installed per day. The impact hammer utilized for installation of pin piles for piled jacket foundations would have a maximum rated capacity of 2,500 kilojoules and would drive the pin piles up to 249.3 feet (76 meters) into the seabed. Three or four pin piles would be driven per day.

As noted above, pile driving will be limited to May 1 – November 30. While BOEM's BA notes that no time-of-day restrictions are proposed for pile driving and that piling may be initiated at any time, the proposed MMPA ITA indicates that initiation of pile driving after dark is not currently proposed. Both the BA and proposed MMPA ITA describe the conditions that Atlantic Shores would need to meet in order for pile driving to be initiated at night. Absent an approved night time monitoring plan, consistent with the description of the action in the proposed MMPA ITA, all pile driving will be initiated during day time (i.e., between one hour after civil sunrise to 1.5 hours before civil sunset), and nighttime pile driving could only occur if unforeseen circumstances (e.g., temporary shutdowns caused by marine mammal or sea turtle sightings, weather or metocean conditions, or equipment repair/maintenance or slower-than-anticipated pile driving speeds caused by geotechnical or other factors) prevent the completion of pile driving during daylight hours and it is necessary to continue piling during the night to protect the asset integrity or safety. BOEM indicates in the BA that no concurrent pile driving is proposed; therefore, concurrent pile driving (i.e., two piles being installed at the same time) is not considered as part of the proposed action. More information on the requirements for night time piling is included below.

As an alternative to piled foundations for the OSSs and met tower, suction bucket foundations (i.e., mono-buckets and suction bucket jackets) may be installed. Project 1 would have five small OSSs, two medium OSSs, or two large OSSs. Project 2 would have five small OSSs, three medium OSSs, or two large OSSs. Mono-buckets consist of a single suction bucket supporting a single tubular structure upon which the structure (e.g., met tower) is mounted, potentially using a transition piece. The suction bucket is generally a hollow steel cylinder capped at one end with the open end facing down into the seabed. A mono-bucket may be used for the met tower foundation. The maximum diameter at the seabed for a mono-bucket jacket would be 115 feet (35 meters). For both Scenario 1 and Scenario 2, up to 1 mono-bucket may be installed for the met tower. Under Scenario 1, this mono-bucket foundation would replace one of the monopile foundations. Under Scenario 2, this mono-bucket foundation would replace either one of the monopile foundations or one of the jacket foundations. Suction bucket jackets consist of vertical steel lattice structures that are fixed to the seabed by suction buckets attached to each leg of the foundation. Each small OSS or met tower suction bucket jacket foundation is expected to have up to four legs, each medium OSS suction bucket jacket foundation is expected to have up to six legs, and each large OSS suction bucket jacket foundation is expected to have up to eight legs. The maximum diameter at the seabed for each suction bucket jacket leg would be 49 feet (15 meters). For both Scenario 1 and Scenario 2, up to 11 suction buckets, with a maximum of 44 legs, may be installed for OSSs and/or the met tower. These suction bucket foundations would replace an equivalent number of monopile foundations under Scenario 1 or an equivalent number of monopile or jacket foundations under Scenario 2.

Suction bucket foundations would be installed using jack-up or heavy lift vessels using dynamic positioning or anchoring. A crane located on the installation vessel would lift the foundation from the transport vessel and lower it to the seabed. The weight of the foundation would result in partial penetration into the seabed. Once the foundation is in place, each suction bucket would be sealed, and pumps would be used to remove water from the bucket, creating a negative pressure differential that would embed the bucket in the seabed. Though the flow rate of the pump would be dependent on the final design of the suction bucket foundation, should this foundation type be selected, Atlantic Shores anticipates that flow rate would be selected to be low enough to avoid seabed disturbance. The pump would be equipped with a screen on the intake to protect pump components. Though the screen size would also be dependent on final design of the suction bucket foundation, Atlantic Shores anticipates that a #20 screen (0.841 mm mesh) would be used on the pump, with specific size dependent on final design of the suction bucket foundation and supply chain availability. After embedment, the space inside the suction bucket may be backfilled with cement grout, if necessary.

As another alternative to piled foundations for the OSSs and met tower, gravity foundations (i.e., gravity-base structures) may be installed. Gravity-based structures are heavy structures composed of steel or steel-reinforced concrete. The base sits on the seabed and may be filled with ballast material, such as seawater. A column connected to the base and extending vertically towards the sea surface supports the tower structure above it. A transition piece may be used to connect the tower to the base. This foundation type may be used for medium or large OSSs and/or the met tower. For the met tower, the maximum diameter at the seabed would be 181 feet (55 meters). For a medium OSS, the maximum size at the seabed would be 263 by 66 feet (80 by 20 meters). For a large OSS, the maximum size at the seabed would be 394 by 98 feet (120 by 30 meters). The bases would penetrate 10 feet (3 meters) below the seabed. For both Scenario 1 and Scenario 2, up to 6 gravity-based structures may be installed for OSSs and/or the met tower. These gravity foundations would replace an equivalent number of monopile foundations under Scenario 1 or an equivalent number of monopile or jacket foundations under Scenario 2.

Gravity foundations would be either transported to the Lease Area onboard a large-capacity barge or floated to the Lease Area using multiple tugboats. If transported, a crane located on a heavy lift vessel would lift the foundation from the barge and lower it to the seabed. Floated foundations would be lowered to the seabed by increasing ballast. Once placed on the seabed, additional ballast material (e.g., seawater, sand [potentially sand dredged during sand bedform removal], gravel, or other crushed minerals or stones) may be pumped into the foundation to provide additional stability. Installation of one gravity foundation per vessel spread per day is anticipated.

3.2.2.1 Scour Protection

Scour protection may be installed around WTG and OSS foundations to prevent scouring (i.e., sediment transport or erosion caused by water currents) of the seabed around the foundations. Proposed scour protection types for foundations described in the BA are:

- Rock placement: up to three layers of rock with increasing rock size in higher layers
- Rock bags: rock-filled filter unit enclosed by polyester mesh
- Grout- or sand-filled bags: bags filled grout or sand
- Concrete mattresses: high-strength concrete blocks cast around a mesh that secures the blocks in a flexible covering
- Ballast-filled mattresses: mattress filled with ballast material (e.g., sand/water/bentonite mixture)
- Frond mattresses: buoyant fronds with similar functionality to natural seaweed densely built into a mattress

Scour protection would extend up to 269 feet (82 meters) from the base of each WTG foundation and be placed to a depth of up to 8.2 feet (2.5 meters), depending on the chosen design. Placement of scour protection for WTG foundations would result in the modification of up to 252 acres (1.0 square km) of seabed under Scenario 1 or up to 215 acres (0.9 square km) under Scenario 2. For the OSSs, scour protection would extend up to 695.5 feet (212 meters) from the base of each foundation and be placed to a depth of up to 8.2 feet (2.5 meters), depending on the chosen design, resulting in the modification of up to 25 acres (0.1 square km) of seabed under either Scenario 1 or Scenario 2.

3.3.3 Cable Installation

As described in BOEM's BA, offshore submarine cabling for the Project includes up to 547 miles (880 km) of inter-array cables, 37 miles (60 km) of interlink cables, and 441 miles (710 km) of submarine export cables. As described in the BA, the inter-array cables would connect the WTGs into strings and then connect these strings to the OSSs. The inter-array cables would consist of three-stranded core high voltage alternating current (HVAC) cables with a transmission capacity of 66 to 150 kilovolts (kV). The Project 1 and Project 2 inter-array cables would have lengths of 273.5 miles (440 km), each. The Project may use interlink cables to connect the OSSs. Interlink cables would consist of three-stranded core HVAC cables with a transmission capacity of 66 to 275 kV. The Project 1 and Project 2 interlink cables would have lengths of 18.6 miles (30 km), each.

Up to eight submarine export cables, occupying up to two corridors, would connect the proposed Project to the onshore electrical grid. There are three transmission options for the offshore export cables: HVAC transmission, high voltage direct current (HVDC) transmission, and HVAC and HVDC transmission. Project 1 is expected to use HVAC transmission; the transmission option for Project 2 may be HVAC or HVDC. Under the HVAC option, Project 1 and Project 2 would each install up to four HVAC cables in separate corridors. Under the HVDC option, Project 1 and Project 2 would each install a two-cable HVDC bundle in separate corridors. Under the HVAC and HVDC option, one project would install up to four HVAC cables and the other would install one HVDC bundle, in either the same or separate corridors. HVAC export cables would have a three-stranded core with a transmission capacity of 230 to 275 kV. HVDC export cables would have a single core with a transmission capacity of 320 to 525 kV. An HVDC project would require the installation of offshore converter stations if selected. In the BA, BOEM notes that only a closed-loop cooling system, which does not require withdrawal or discharge of cooling water, is considered part of the proposed action. Therefore, this consultation does not consider the effects of an open loop cooling system or any effects of the discharge or intake of cooling water.

The proposed action includes two export cable routes. The Atlantic Export Cable Corridor would depart the Lease Area along its western boundary and travel northwest to the Atlantic Landfall Site in Atlantic City, New Jersey. The Atlantic cable route is approximately 12 miles (19 km) long, and maximum length of each export cable using the Atlantic cable route would be 25 miles (40 km), including the length of cable within the Lease Area and contingency for micrositing. The Monmouth Export Cable Corridor would depart the Lease Area along its eastern boundary and travel north to the Monmouth Landing Site in Sea Girt, New Jersey. The Monmouth cable route is approximately 61 miles (98 km) long, and the maximum length of each export cable using the Monmouth cable route would be 85 miles (138 km), including the length of cable within the lease area and contingency for micrositing.

Prior to cable installation, Atlantic Shores would carry out pre-installation activities, including sand bedform clearing, relocation of boulders, a pre-lay grapnel run, and a pre-lay survey. Sand bedform clearing would involve the removal of the tops of some mobile sand bedforms to ensure cables can be installed within stable seabed. Project engineers estimate that up to 20 percent of export cable routes, 20 percent of interlink cable routes, and 10 percent of interarray cable routes may require sand bedform clearing, for a total of up to 1,794.09 acres. Such clearing is expected to be completed with controlled flow excavation, route clearance plow, or backhoe dredging methods. Material collected during sand bedform clearing may be sidecast; disposed of within surveyed areas exhibiting sand bedforms, which avoids hard bottom areas and allow material to be dispersed by normal currents and tidal actions; used for ballast in gravity-based foundations, if selected; or transported for disposal in another approved/permitted area. Up to approximately 4.2 million cubic yards of material would be removed or relocated during sand bedform clearing.

Boulder relocation may occur in limited areas along the export cable corridors. Presence of boulders is expected to be minimal, and boulder removal would likely be performed using subsea grab, a method with minimal seabed impact. If more boulders are encountered than expected, a displacement plow may be utilized for boulder removal. A displacement plow is a y-shaped tool configured with an attached boulder board that is towed along the seabed, displacing boulders along its path as it advances. If this method is necessary, the plow would be ballasted to only clear boulders (approximate seabed penetration of 2.6 feet [0.8 meters]), avoiding creation of a deep depression in the seabed. The clearance width of the displacement plow is anticipated to be approximately 33 feet (10 meters). The maximum total length of boulder relocation is estimated at 35.1 miles (71 km), with an additional area of disturbance up to 0.08 square miles (0.22 square km).

A pre-lay grapnel run would be completed approximately two months prior to cable installation to clear final cable alignments of man-made obstructions (e.g., discarded fishing gear). Three grapnel runs along each cable alignment are anticipated. During the pre-lay grapnel run, the seabed would be impacted to a maximum depth of 1.6 feet (0.5 meters). Pre-lay surveys would be performed along final cable alignments to confirm seabed morphology and bathymetry prior to the start of cable laying operations. These surveys would be performed using a multibeam echosounder. We note that no detonation or disposal of unexploded ordnance or munitions is described in the BA; as such, it is not considered part of the proposed action and effects of such activities are not considered in this consultation.

Once the pre-installation activities are completed, Atlantic Shores would lay and bury the export, interlink, and inter-array cables. Cable lay and burial may be completed using three methods:

- Simultaneous lay and burial: Cable is directly guided from the installation vessel through the burial tool and laid into the seabed. Atlantic Shores expects to use this method for installation of export cables
- Post-lay burial: Cable is temporarily laid on the seabed then buried in a subsequent, separate operation. This method leaves the cables unprotected between laying and burial operations, but burial can be completed more quickly, minimizing duration of cable installation impacts, and multiple passes with the burial tool can be completed to reach target burial depth, minimizing the need for cable protection. Atlantic Shores expects to use this method for installation of inter-array and interlink cables
- Pre-lay trenching: A trench is excavated prior to cable installation, cable is laid into the trench, and the trench is backfilled with spoils from trench excavation. This method would be limited to portions of cable alignments where deeper cable burial is required, or firmer sediments are encountered.

The BA describes a variety of tools to perform cable lay and burial operations. Final equipment selection will be based upon seabed conditions, cable properties, laying and burying combinations, burial tool systems, and anticipated performance.

- Jet trenching: Involves injecting pressurized water jets into the seabed, creating a trench. This equipment can be used in soft sediments for either simultaneous lay and burial or post-lay burial techniques
- Plowing/jet plowing: As the plow is dragged along the seabed, a trench to the required burial depth is created and held open. As the plow advances, the cable is placed in the trench and displaced sediment is either mechanically returned to the trench or backfills naturally. This equipment is typically used for simultaneous lay and burial
- Mechanical trenching: This tool cuts a narrow trench into the seabed using a jetting sword or excavation chain, and cable is buried in the trench either simultaneously or subsequently. This equipment is generally used in firmer sediments for simultaneous lay and burial, post-lay burial, and pre-lay trenching techniques.

Atlantic Shores anticipates the majority of offshore cable installation will utilize jet trenching equipment or jet plowing. Mechanical trenching is only expected in limited areas. Approximately 80 to 90 percent of offshore cables are expected to require only one pass of the cable installation tool. In the remaining areas, two to four passes may be required to reach target burial depth. Along approximately 5 percent of the export cable corridors, an additional pass may be performed prior to cable installation (i.e., re-pass jetting) to increase the probability of successful cable burial. In shallow portions of the export cable corridor, a fourth tool may be used to perform simultaneous lay and burial: a plow towed by a shallow-water barge with tensioners.

In areas where burial of the cables to the target depth (5 to 6.6 feet [1.5 to 2 meters]) is not feasible, cable protection would be installed on the seabed above the cable as a secondary measure to protect the cables. Cable protection may also be necessary to support the crossing of existing marine infrastructure (e.g., submarine cables or pipelines). Atlantic Shores anticipates up to 15 crossings for each of the four export cables along the Monmouth Export Cable Corridor, up to 4 crossings for each of the four export cables along the Atlantic Export Cable Corridor, up to 10 inter-array cable crossings, and up to 2 interlink cable crossings.[10] Any cable crossing would be surveyed. If the existing cable is inactive, it will be cut and removed prior to installation of the proposed cable. For any active cable identified, Atlantic Shores will develop a crossing agreement with the owner. If the depth of the existing cable is sufficient to maintain appropriate vertical separation, Atlantic Shores will bury their cable to target depth at the crossing. If target depth cannot be achieved, cable protection would be installed on top of the proposed cable.

In the BA, BOEM assumes that up to 10 percent of offshore cables (i.e., 54.6 miles [88 km] of inter-array cables, 3.8 miles [6 km] of interlink cables, and 44.1 miles [71 km] of export cables) may require cable protection due to insufficient burial depth. Cable protection for insufficient burial depth would extend to a width of up to 41 feet (12.5 meters) and a depth of up to 4.6 feet (1.4 meters). Additionally, cable protection may be required for up to 88 infrastructure crossings. At infrastructure crossings requiring cable protection, protection may cover an area of up to 43,055.6 square feet (4,000 square meters) with a maximum depth of 5.6 feet (1.7 meters). Proposed types of cable protection described in the BA are:

- Rock placement: Up to three layers of rock, with rock size increasing in higher layers
- Concrete mattresses: High-strength concrete blocks cast around mesh that holds the blocks in a flexible covering
- Rock Bags: Rock-filled filter unit enclosed by polyester mesh
- Grout-filled bags: Woven fabric filled with grout
- Half-shell pipes: Composite materials or cast iron that is fixed around a cable.

Where cable protection is required, freely-laid rock, if selected as the cable protection type, would be placed using a fallpipe installation method, wherever possible. Alternative rock laying techniques would include placement by vessel crane and side dumping. If concrete mattresses, rock bags, or grout-filled bags are selected for cable protection, they would be deployed using a vessel crane. Half-shell pipes would be installed around the cable on board the cable laying vessel prior to cable installation.

Given the length of the export cables, cable jointing offshore would be required. The end of each cable segment would be held in temporary wet storage on the seabed, which may require temporary cable protection (e.g., concreted mattresses) to be placed over the cable end. Once the cable segments are jointed onboard a jointing vessel, the joints would be buried using either a jet trencher or controlled flow excavation. If sufficient burial is not possible, cable protection would be placed on top of the joint. Depending on the final construction and installation schedule, the ends of the export cables may need to be wet-stored and covered with cable protection until they are pulled into the foundation.

Installation of the export cables would occur over a 6- to 9-month period, likely beginning in the second quarter of 2025 for Project 1 and the third quarter of 2025 for Project 2. Installation of

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[10] As noted in the BA, in developing these estimates, Atlantic Shores accounted for the possibility that other offshore cables (e.g., export cables from other offshore wind farms) may be installed prior to the start of the Project's construction.

the inter-array cables would occur over a 14-month period, likely beginning in the second quarter of 2026 for Project 1 and the third quarter of 2026 for Project 2.

3.2.3.1 Sea-to-Shore Connection
Atlantic Shores will connect the export cables at the two landfall locations (Atlantic City and Monmouth) via Horizontal Directional Drilling (HDD). HDD would involve drilling underneath the sea floor using a drilling rig positioned onshore at the landfall location.

Each HDD exit pit would be excavated with a backhoe dredge; Atlantic Shores anticipates the HDD pit for each cable landfall would be 98.4 by 26.2 feet (30 m by 8 m), resulting in up to 0.12 acres of dredging. Up to four temporary sheet pile cofferdams will be installed at each of the two landfall locations using a vibratory hammer. Each cofferdam would be composed of approximately 109 sheet piles, with a total of 872 sheet piles for all 8 cofferdams combined. The cofferdams at each landfall site are anticipated to require 8 days to install and 8 days to remove (i.e., 16 total days of vibratory hammer operation at each landfall site). Cofferdam installation would only occur between Labor Day and Memorial Day (i.e., between early September and late May).

3.4 Operations and Maintenance (O&M)
As described in the BA and COP, once operational, the Projects will be supported by a new O&M facility that Atlantic Shores is proposing to establish in Atlantic City, New Jersey. The facility will be used for O&M operations including material storage, day-to-day management of inspection and maintenance activities, vehicle parking, marine coordination, vessel docking, and dispatching of technicians.

During operation, the WTGs would be remotely monitored through the SCADA system, which acts as an interface for a number of sensors and controls throughout the wind farm. The SCADA system allows status and performance to be monitored and for systems to be controlled remotely, where required. The WTGs will be regularly inspected and maintained. Generally, WTG O&M activities would include:

- Regularly scheduled inspections and routine maintenance of the WTG mechanical and electrical components
- Annual maintenance campaigns for general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection)
- Replacement of consumable items (e.g., lubrication, oil changes) and scour materials.

During O&M, foundations would be inspected above and below the waterline at regular intervals to check for corrosion, cracking, and marine growth. Scheduled maintenance would also include safety inspections and testing; coating touch-up; preventative maintenance of cranes, electrical equipment, and auxiliary equipment; and removal of marine growth. Corrective actions will be taken as necessary to address any issues identified with scour protection.

The submarine export cables would be monitored through either a distributed temperature sensing system, a distributed acoustic sensing system, or online partial discharge monitoring.

Cable terminations and hang-offs would be inspected and maintained during scheduled maintenance of WTG and OSS foundations.

Regular cable surveys would be performed to identify potential issues with scour or burial depth. During the first two to five years of operation, cable surveys would be performed annually. The duration of annual surveying will be determined based on the results of the initial surveys. Assuming no abnormal conditions are identified during initial annual surveys, less frequent cable surveys would be conducted over the remaining life of the Project. Post-construction HRG surveys are anticipated to operate during any month of the year for a maximum of 60 vessel days per year, on average, for up to five years, 55 line km per day at a typical speed of 3.5 knots, resulting in an estimated 3,300 line km surveyed annually. Provided that no abnormal conditions are detected during these annual surveys, less frequent HRG surveys would be conducted throughout the remaining life of the Project (see additional information in HRG survey section below).

In the unlikely event of cable exposure, the cable would be reburied or cable protection would be applied. Should unplanned repairs be required, the damaged portion of the cable will be spliced and replaced with a new, working segment. This will require the use of various cable installation equipment, as described for construction activities.

During O&M activities, personnel and equipment would primarily be delivered to the Lease Area by service operation vessels and CTVs. During the O&M phase, 5 to 11 vessels are expected to operate in the Lease Area at a given time. During specialized maintenance or repair activities, a maximum of 22 vessels may be required. The estimated number of annual vessel round-trips to the Lease Area during O&M is 1,861 trips. Helicopters may also be used to support O&M activities.

To support operation and maintenance of WTGs, each WTG would require various oils, fuels, and lubricants. A spill containment strategy for each WTG would be comprised of preventive, detective, and containment measures. These measures include 100 percent leakage-free joints to prevent leaks at the connectors, high-pressure and oil level sensors that can detect both water and oil leakage, and appropriate integrated retention reservoirs capable of containing 110 percent of the volume of potential leakages at each WTG. Table 3.5 provides a summary of the maximum quantities of these materials potentially required for each WTG.

Table 3.5 Summary of the Maximum Potential Quantities of Oils, Fuels, Gases, and Lubricants (for 200 WTGs)

WTG oil and grease	606,200 gal (2,294,717 L)
WTG coolant	820,000 gal (3,104,038 L)
WTG fuel	80,000 gal (302,833 L)
OSS oil and grease	370,050 gal (2,801,436 L)
OSS coolant	10,300 gal (38,990 L)
OSS fuel	75,000 gal (283,906 L)

A representative schedule of the Projects' inspection and maintenance activities is presented in the table below. As described in the COP (Section 5.4), this schedule provides an overview of the estimated frequency of inspection and maintenance activities.

Table 3.6 Anticipated Inspection and Maintenance Activities

Project Component	Activity	Frequency
WTG	Inspections	Annual
	Maintenance of mechanical, electrical, structural, and safety systems	Annual
	Retrofits/upgrade	As needed
	Gearbox oil change	2-3 times over lifespan, as needed
OSS	Inspections	Annual
	Maintenance of medium-voltage and high-voltage systems, auxiliary systems, and safety systems	Annual
	Diesel generator refueling	As needed
Foundation	Above water inspection	Annual
	Below water inspection	20% of positions per year (may be modified based on site and design risk assessment)
	Maintenance of structural, auxiliary, and safety systems	Annual
Offshore Cables (Export, Inter- Array, and Inter-Link)	Survey	Annually during the first few years of operations and at less frequent intervals thereafter (may be modified based on site and design risk assessment)
	Electrical tests	Every 5 years
Onshore Substation and/or Converter Station	Inspection	Annual
	Maintenance of medium-voltage and high-voltage systems, auxiliary systems, and safety systems	Annual
Onshore Interconnection Cables	Visual and thermographic inspections of cables and terminations inside vaults	Annual
	Electrical tests	Every 5 years

source: Table 5.4-1 in Atlantic Shores COP

3.5 Decommissioning

The projects would be decommissioned and removed at the end of their approximately 35-year operating period. As described in the BA, BOEM's decommissioning requirements are stated in Section 13, *Removal of Property and Restoration of the Leased Area on Termination of Lease*, of the December 2018 Lease for OCS-A 0499. Unless otherwise authorized by BSEE, pursuant to the applicable regulations in 30 CFR Part 285, Atlantic Shores would be required to "remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on leased area, including any project easement(s) within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with any approved SAP, COP, or approved Decommissioning Application and applicable regulations in 30 CFR Part 285." BOEM may authorize facilities to remain in place. When possible, decommissioning would recover valuable recyclable materials, including steel foundation components.

In accordance with BSEE requirements, Atlantic Shores would be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions when the Project reaches the end of its 30-year designed service life. Before ceasing operation of individual WTGs or the entire Project and prior to decommissioning and removing Project components, Atlantic Shores would consult with BSEE and submit a decommissioning plan for review and approval. Upon receipt of the necessary BSEE approval and any other required permits, Atlantic Shores would implement the decommissioning plan to remove, and recycle, when possible, equipment and associated materials.

The decommissioning process for the WTGs and OSSs, with their associated foundations, is anticipated to generally be the reverse of installation, with Project components transported to an appropriate disposal and/or recycling facility. All foundations and other Project components would need to be removed 15 feet (4.6 meters) below the mudline, unless other methods are deemed suitable through consultation with BSEE and other applicable regulatory authorities, including BOEM. Submarine export and inter-array cables would be retired in place or removed in accordance with the BSEE-approved decommissioning plan. Atlantic Shores would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Project components will be decommissioned using a similar suite of vessels as Project construction.

Vessel classes and numbers for decommissioning are expected to be similar to the construction and installation phase. Therefore, in the unlikely event that all decommissioning activities for Project 1 and Project 2 were to occur simultaneously, up to 51 vessels could be operating at a given time. The total estimated number of vessel round-trips to the Lease Area during decommissioning is 1,745 trips. In the BA, BOEM has indicated that it is difficult to predict the amount of vessel traffic and the ports to be used to support decommissioning but that they are expected to be substantially similar to vessel traffic during construction.

3.6 Surveys and Monitoring

Atlantic Shores is proposing to carry out, or BOEM is proposing to require that Atlantic Shores carry out as conditions of COP approval, high-resolution geophysical (HRG) surveys and a number of ecological surveys/monitoring activities. These activities are described in the BA and are part of the proposed action that BOEM has requested consultation.

3.6.1 High-Resolution Geophysical Surveys and Geotechnical Surveys

Intermittent geophysical surveys would be conducted prior to and during construction, operations, and decommissioning to identify any sea floor debris, MEC/UXO, and cultural and historical resources, and to survey for as-built requirements, O&M, and site clearance purposes. HRG surveys would be conducted prior to construction and installation to finalize design and support micrositing of project features such as foundations and cables. HRG surveys use a combination of sonar-based methods to map shallow geophysical features. The survey equipment is typically towed behind a moving survey vessel attached by an umbilical cable. HRG survey vessels move slowly, with typical operational speeds of less than approximately 4 knots.

These surveys are expected to utilize active acoustic equipment including multibeam echosounders, side scan sonars, shallow penetration sub-bottom profilers (SBPs) (*e.g.*, Compressed High-Intensity Radiated Pulses (CHIRPs) non-parametric SBP), medium penetration sub-bottom profilers (e.g., sparkers and boomers), ultra-short baseline positioning equipment, and marine magnetometers. Surveys would occur annually, with durations dependent on the activities occurring in that year (i.e., construction year versus a non-construction year). The purpose of surveying during non-construction years is to monitor seabed levels and scour protection, identify any risks to inter-array and export cable integrity, and conduct seabed clearance surveys prior to maintenance/repair. Additionally, grab sampling is proposed to validate seabed classification.

BOEM has completed a programmatic ESA consultation with NMFS for HRG surveys and other types of survey and monitoring activities supporting offshore wind energy development (NMFS 2021a; Appendix C to this Opinion), inclusive of the equipment proposed for use by Atlantic Shores. As described in the Atlantic Shores BA, BOEM will require the Lessee to comply with all relevant programmatic survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA consultation; these measures are detailed in Appendix B of the programmatic consultation (see Appendix C of this Biological Opinion for a copy of the programmatic consultation). HRG surveys and grab sampling related to the approval of the Atlantic Shores COP are considered part of the proposed action evaluated in this Opinion and the applicable survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA consultation are incorporated by reference. They are thus also considered components of the proposed action evaluated in this Opinion.

As described in the proposed MMPA ITA, Atlantic Shores' HRG surveys would utilize up to three vessels working concurrently in different sections of the Lease Area and ECCs. No HRG surveys would occur concurrently with impact pile driving activities. All vessels would be operating several km apart at any one time. On average, 55 km (34.2 mi) would be surveyed each survey day, per vessel, at a speed of approximately 6.5 km/hour (3.5 knots). Atlantic Shores anticipates up to 60 days of survey activities would occur annually.

3.6.2 Fisheries and Benthic Monitoring

Atlantic Shores is proposing to implement their Fisheries Monitoring Plan (COP Appendix II-K); in the BA, BOEM identified this as part of the Proposed Action for this ESA consultation. The Plan describes a trawl survey, fish pot surveys, and hydraulic clam dredge surveys. Atlantic Shores is also proposing to implement a Benthic Monitoring Plan (COP Volume II, Appendix II-H, *Benthic Monitoring Plan*; Atlantic Shores 2023a).

Demersal Otter Trawl Surveys

Otter trawl surveys will be carried out to assess abundance and distribution of target fish and invertebrate species. Trawls will be carried out in three strata (effects, close control, and far control). Each strata (effects and both controls) will be sampled with 9 tows in the winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November) for a total of 108 tows per year. Sampling will occur for at least one year prior to construction, during construction wherever feasible, and in the three years post-construction for a total of up to 7 years of surveys. Surveys are expected to begin as soon as January 2024. The trawl survey will use sampling gear and protocols consistent with the Virginia Institute of Marine Science's (VIMS) Northeast Area Monitoring and Assessment Program (NEAMAP) trawl survey. Tow times will be limited to 20-minutes and will only occur during daylight.

Fish Pot Survey

The trap survey will follow a "BAG" design with sample sites located at regular distances from WTG or OSS locations. The first trap in a trawl will be set as close to the WTG (or planned WTG location for baseline survey) as safely as possible (roughly 20 m) with remaining traps set at nearly logarithmic intervals of about 15 m (50 ft.), 50 m (164 ft.), 150 m (492 ft.), 400 m (1,312 ft.), and 1,100 m (3,608 ft.) from the first trap (further referred to as a "transect"). Transect locations selected for the first survey will be repeated for subsequent surveys. Twelve transects of six traps will be left to soak for two, one-week (5-7 day) periods in each of four seasons (winter, spring, summer, and fall) for a total of 72 traps sampled eight times per year. Sampling will occur for at least one year prior to construction, during construction wherever feasible, and in the three years post-construction, for a total of up to 7 years of surveys. Ropeless/on-demand technology will be used to eliminate vertical lines marking the location of the traps. All gear will be removed from the water between surveys. Cameras will be added to each trap in one transect each sampling period.

Hydraulic Clam Dredge Survey

The dredge survey will take place in three strata. The effects group (i.e., effects strata) will consist of all tows conducted within 0.9 km (km) (0.5 nm) of the footprint of the outermost wind turbine generators (WTGs) and offshore substations (OSSs) in the WFA. One control group (i.e., "close control strata") will contain tows outside the WTG footprint with a time-weighted average distance between 0.9 - 2.8 km (0.5 - 1.5 nm) from the nearest turbine and the second control group (i.e., "far control strata") will contain tows outside the WTG footprint with a time-weighted average distance between 2.8 - 5.6 km (1.5 - 3 nm) from the nearest turbine (Figure 3-3). Each strata (effects and both controls) will be sampled with 16 tows (48 total) once a year in the summer. Sampling will occur for at least one year prior to construction, during construction wherever feasible, and in the three years post-construction for a total of up to 7 years of surveys.

Sampling will be conducted with the same dredge gear as the NJDEP inventory of New Jersey's surf clam resources survey (NJDFW 2010 as cited in BOEM's BA). The dredge will have the knife depth set at 5 inches. The floor, door, and storage end will be lined with 51 mm (2 in) by 51 mm mesh.

Benthic Habitat Studies

Proposed benthic habitat studies include grab sampling and underwater imagery (COP Volume II, Appendix II-H, *Benthic Monitoring Plan*; Atlantic Shores 2023a). Grab sampling would be conducted in the WFA and export cable corridors with a benthic grab sampler. Grab sampling would occur once per year in the year prior to construction activities, within the first year after Project completion, in the third year after Project completion, and potentially in the fifth year after Project completion, with 378 grabs collected during each annual sampling event.

Underwater imaging would include video survey transects in the wind turbine area and within the export cable corridors and remotely operated vehicle surveys around selected WTG foundations. Video surveys would be conducted using a towed camera sled or remotely operated vehicle and an additional still image camera. Underwater imagery would be collected in the same years that benthic grab sampling occurs.

3.5.3 Passive Acoustic and Other Environmental Monitoring

The periodic deployment of moored passive acoustic monitoring (PAM) platforms, autonomous surface vehicles (ASVs), or autonomous underwater vehicles (AUVs) to record ambient noise and marine mammal vocalizations in the Lease Area before, during, and after construction over the life of the project to monitor construction and operational noise is anticipated. One or more of these technologies may be deployed over time to monitor project impacts relating to vessel noise, pile driving noise, HRG surveys, WTG operational noise, and/or to document whale detections in the WDA. BOEM will require the archival recorders to have a minimum capability of detecting and storing acoustic data on anthropogenic noise sources, and vocalizing marine mammals, in the Lease Area. Monitoring will be conducted using the data collection, processing methods, and visualization metrics developed by the Atlantic Deepwater Ecosystem Observatory Network (ADEON) for the U.S. Mid- and South Atlantic OCS (see https://adeon.unh.edu/). Meteorological buoys to provide real-time weather data are proposed to be temporarily deployed in the Project area during construction and operations. All device deployments will comply with the project design criteria and best management practices included in NMFS 2021 informal programmatic consultation on site assessment activities (see Appendix B to the programmatic consultation) which have been incorporated by reference as part of the proposed action in this opinion and attached as Appendix C.

3.7 Vessels and Aircraft Proposed for the Atlantic Shores Projects

As described in the BA, various types of vessels will be used during construction and installation, O&M, and decommissioning. The construction and decommissioning phases would involve the most vessel based activity over relatively short-term periods, whereas O&M-related vessel traffic would occur intermittently over the life of the project. The information presented in the BA is summarized here.

Atlantic Shores has identified various vessels and helicopters that would be used to support construction and operations and maintenance of the Project. Each vessel would have operational Automatic Identification Systems (AIS), which would be used to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. Similarly, all aviation operations, including flying routes and altitude, would be aligned with the Federal Aviation Administration. Construction and installation vessels will operate over a three year period (currently anticipated 2025-2027). In the BA, BOEM identifies that vessels would use existing port facilities located in the following locations: New Jersey Wind Port (Lower Alloways/Salem), Paulsboro Marine Terminal, and Repauno (Gibbstown), New Jersey; Portsmouth, Virginia; and Corpus Christi, Texas; as well as a new O&M facility in Atlantic City, New Jersey. Tables 3.7 and 3.8 summarize the various vessels associated with project-related offshore construction and installation.

Table 3.7 Vessel Types planned for use during construction and O&M phases

Activity	Vessel Type	Length (ft.)	Width (ft.)	Draft (ft.)	Operational Speed (knots)
Construction					
Foundation Installation	Barge	394-410	98-115	4.3	3-10
	Bubble Curtain Support Vessel (Tugboat)	230-246	49-66	6.9	10
	Crew Transfer Vessel	82-98	30-33	1.5	29
	Dredger	640-656	131-148	4.3	10
	Fall Pipe Vessel	623-640	131-148	9.25	10
	Jack-Up Vessel	591-607	197	7.5	10
	Towing Tug	98-115	33-49	5.5	3-10
OSS Installation	Barge	394-410	98-115	4.3	10
	Crew Transfer Vessel	82-98	30-33	1.5	29
	Heavy Lift Vessel	591-722	131-295	10	10
	Towing Tug	98-115	30-33	5.5	10
WTG Installation	Crew Transfer Vessel	82-98	30-33	1.5	29
	Jack-Up Feeder	407-410	128-131	7.5	10
	Jack-Up Vessel	591-607	197	7.5	10
	Service Operations Vessel	295-344	49-66	8	10
Inter-Array Cable Installation	Anchor Handling Vessel	246-262	49-66	8	10
	Cable Burial Vessel	246-541	82-115	9	10
	Cable Installation Vessel	246-541	82-115	9	10
	Dredger	640-656	131-148	4.3	10

Activity	Vessel Type	Length (ft.)	Width (ft.)	Draft (ft.)	Operational Speed (knots)
Construction					
	Fall Pipe Vessel	623-640	131-148	9.25	10
	Support Vessel (SOV)	295-344	49-66	8	10
Export Cable Installation	Cable Installation Vessel	246-541	82-115	9	10
	Dredger	640-656	131-148	4.3	10
	Fall Pipe Vessel	640-656	131-148	9.25	10
	Support Vessel (SOV)	312-328	66	8	10
	Tug	98-115	33-49	5.3	10
Scour Protection Installation	Fall Pipe Vessel	623-640	131-148	9.25	10
	Dredger	640-656	131-148	4.3	10
Miscellaneous	Barge	394-410	98-115	4.3	3-10
	Tug	98-115	30-33	5.5	3-10
Operations/Maintenance					
Various	CTV	82-98	30-33	1.5	29
	Miscellaneous (as needed)	N/A	N/A	N/A	10
	SOV	312-328	66	8	10

source: Table 1-8 in BOEM's BA

Table 3.8. Anticipated vessel transits with anticipated ports by vessel type. Total trips represent the total number of trips, during which vessels may travel to the listed 'Ports that may be Used' in any combination up to that total number of trips.

State	Potential Port(s)	Estimated Trips[1]
Construction		
New Jersey	New Jersey Wind Port	1,250
	Paulsboro	120
	Repauno	20
	Atlantic City	315
Virginia	Portsmouth	20
Texas	Corpus Christi	20
O&M		
New Jersey	New Jersey Wind Port	32
	Paulsboro	2
	Repauno	1
	Atlantic City	1,825[2]
Virginia	Portsmouth	1
Decommissioning[3]		

New Jersey	New Jersey Wind Port	1,250
	Paulsboro	120
	Repauno	20
	Atlantic City	315
Virginia	Portsmouth	20
Texas	Corpus Christi	20

[1] Estimated trips for construction and decommissioning represent total round trips during these phases of the Project. Estimated trips for O&M represent annual round trips during this phase of the Project.
[2] Assumes 5 trips of crew transfer vessels per day for maintenance of the 200 WTGs.
[3] Estimated trips during decommissioning are assumed to be the same as during construction.
source: Table 1-9 in BOEM's BA

3.8 Minimization and Monitoring Measures that are part of the Proposed Action

There are a number of measures that Atlantic Shores, through its COP, is proposing to take and/or BOEM is proposing to require as conditions of COP approval that are designed to avoid, minimize, or monitor effects of the action on ESA listed species. For the purpose of this consultation, the avoidance, minimization, and monitoring measures proposed by BOEM and/or USACE and identified in the BA as part of the action that BOEM is requesting consultation on are considered as part of the proposed action. Additionally, NMFS OPR includes a number of measures to avoid, minimize, or monitor effects in the proposed MMPA ITA (see below); these measures are also considered as part of the proposed action for this consultation. The proposed ITA only proposes mitigation and monitoring measures for marine mammals including the threatened and endangered whales considered in this Opinion. Although some measures for marine mammals also apply to and provide minimization of potential impacts to listed sea turtle and fish species (e.g., pile driving soft start minimize potential effects to all listed species), they do not completely cover all threatened and endangered species avoidance, minimization, mitigation, monitoring, and reporting needs. The measures proposed by Atlantic Shores and/or BOEM are considered part of the proposed action, and thus mandatory for implementation through enforceable conditions in applicable approvals, authorizations and permits, are described in Table 1-10 and 1-11 in BOEM's BA. For ease of reference, these are copied into Appendix A of this Opinion. These are in addition to the conditions of the proposed ITA, which are also part of the proposed action (see Appendix B). We note that the final MMPA ITA may contain measures that include requirements that may differ from the proposed rule; as explained in this Opinion's ITS, compliance with the conditions of the final MMPA ITA is necessary for the ESA take exemption to apply to ESA-listed marine mammals. We therefore consider any measures specified in the proposed MMPA ITA to be mandatory elements of the proposed action while acknowledging that they may be modified or supplemented in the final MMPA ITA and specified as additional non-discretionary measures in the ITS.

BOEM and NMFS OPR are proposing to require monitoring of clearance and shutdown zones before and during pile driving. More information is provided in the *Effects of the Action* section of this Opinion. These zones are summarized in table 3.9. In addition to the clearance and shutdown zones, the MMPA ITA identifies a minimum visibility zone for foundation pile driving. This is the distance from the pile that the visual observers must be able to effectively monitor for marine mammals; that is, lighting, weather (e.g., rain, fog, etc.), and sea state must be sufficient for the observer to be able to detect a marine mammal within that distance from the pile.

The clearance zone is the area around the pile that must be declared "clear" of marine mammals and sea turtles prior to the activity commencing. The size of the zone is measured as the radius with the impact activity (e.g., pile) at the center. For sea turtles, the area is "cleared" by visual observers determining that there have been no sightings of sea turtles in the identified area for a prescribed amount of time. For marine mammals, both visual observers and passive acoustic monitoring (PAM, which detects the sound of vocalizing marine mammals) will be used; the area is determined to be "cleared" when visual observers have determined there have been no sightings of marine mammals in the identified area for a prescribed amount of time and, for North Atlantic right whales in particular, if no right whales have been visually observed in any area beyond the minimum clearance zone that the visual observers can see. Further, the PAM operator will declare an area "clear" if they do not detect the sound of vocalizing whales within the identified PAM clearance zone for the identified amount of time. Pile driving cannot commence until all of the required clearance zones are determined to be clear of marine mammals and sea turtles.

Once pile driving begins, the shutdown zone applies. If a marine mammal, including ESA-listed species, or sea turtle is observed by a visual PSO entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless Atlantic Shores and/or its contractor determines shutdown is not feasible due to an imminent risk of injury or loss of life to an individual; or risk of damage to a vessel that creates risk of injury or loss of life for individuals. For right whales, shutdown is also triggered by: the visual PSO observing a right whale at any distance (i.e., even if it is outside the shutdown zone identified for other whale species), and a detection by the PAM operator of a vocalizing right whale at a distance determined to be within the identified PAM shutdown zone. If shutdown is called for but Atlantic Shores and/or its contractor determines shutdown is not feasible due to imminent risk of injury or loss of life, reduced hammer energy must be implemented when the lead engineer determines it is practicable. As described by BOEM and Atlantic Shores there are two scenarios, approaching pile refusal and pile instability, where this imminent risk could be a factor; however, Atlantic Shores describes a low likelihood of occurrence for the pile refusal/stuck pile or pile instability scenario as explained below. Atlantic Shores notes that other unpredictable scenarios may occur that would present an imminent risk of injury or loss of life such that shutdown would not be feasible; any such incidences are expected to be rare.

Stuck Pile

If the pile driving sensors indicate the pile is approaching target depths and/or refusal, and a shut-down would lead to a stuck pile, shut down may be determined to be infeasible if the stuck pile is determined to pose an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. Atlantic Shores notes that the risk comes from the pile settling prior to reaching target depth which may make it unusable and present concerns regarding stability. The pile could then fall and damage the vessel and/or personnel on board the vessel. The lessee describes their mitigation of this risk as follows, each pile is specifically engineered to manage the sediment conditions at the location at which it is to be driven, and therefore designed to avoid and minimize the potential for piling refusal. They will use pre-installation engineering assessments with real-time hammer log information during installation to track progress and continuously judge whether a stoppage would cause a risk of injury or loss of life. Due to this advanced engineering and on-site construction, BOEM and the lessee expect that circumstances under which piling could not stop if a shutdown is requested are very limited.

Pile Instability

A pile may be deemed unstable and unable to stay standing if the piling vessel were to "let go." During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shutdown combined with impending weather conditions may require the piling vessel to "let go" which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals from a falling pile. As described by BOEM, weather conditions criteria will be established that determine when a piling vessel would have to "let go" of a pile being installed for safety reasons. To reduce the risk that a requested shutdown would not be possible due to weather, project personnel will actively assess weather, using two independent forecasting systems. Initiation of piling also requires a Certificate of Approval by the Marine Warranty Supervisor. In addition to ensuring that current weather conditions are suitable for piling, this Certificate of Approval process considers forecasted weather for 6 hours out and will evaluate if conditions would limit the ability to shut down and "let go" of the pile. If a shutdown is not feasible due to pile instability and weather, piling would continue only until a penetration depth sufficient to secure the pile is achieved. As piling instability is most likely to occur during the soft start period, and soft start cannot commence till the Marine Warranty Supervisor has issued a Certificate of Approval that signals there is a current weather window of at least 6 hours, the likelihood is low for the pile to not achieve stability within the 6-hour window inclusive of stops and starts.

Table 3.9. Proposed clearance and exclusion zones.

These are the PAM detection, minimal visibility, clearance and shutdown zones incorporated into the proposed action; the zones for marine mammals reflect the proposed conditions of the MMPA ITA (as updated by NMFS OPR during the consultation period), and the zones for sea turtles reflect the zone sizes proposed by BOEM (as updated by NMFS OPR during the consultation period). Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility and clearance zones. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving; detection of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Impact pile driving for WTG, OSS, and Met Tower foundation installation: 1,900 m minimum visibility zone from each PSO platform (pile driving vessel and at least two PSO vessels), PAM monitoring out to 10,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM
Fin, sei, and sperm whale (visual and PAM monitoring)	2,300 m (visual or PAM detection)	1,900 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)
Vibratory Pile Driving for Cable Landfall Activities -visual PSOs		
NARW, fin, sei, and sperm whale	100 m	100 m
Sea Turtles	50 m	50 m
HRG Surveys – visual PSOs		
NARW	500 m	500 m
Fin, Sei, and Sperm Whales	500 m	100 m
Sea Turtles	100 m	100 m

3.9 MMPA Incidental Take Authorization (ITA) Proposed for Issuance by NMFS

In response to their application, the NMFS Office of Protected Resources (OPR) has proposed to issue Atlantic Shores an ITA for the take of small numbers of marine mammals incidental to construction of the project with a proposed duration of five years, it is anticipated that the proposed regulation would be effective from January 1, 2025 to December 31, 2029. More information on the proposed Incidental Take Regulation (ITR) and associated Letter(s) of Authorization (LOA), including Atlantic Shores' application is available online (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-atlantic-shores-offshore-wind-llc-construction-atlantic-shores*). As described in the Notice of Proposed Rule (88 FR 65430; September 22, 2023), take of marine mammals may occur incidental to the construction of the project due to in-water noise exposure resulting from Project activities likely to result in incidental take include pile driving (impact and vibratory) and vessel-based site assessment surveys using high-resolution geophysical (HRG) equipment.

3.9.1 Amount of MMPA Take Proposed for Authorization

The proposed ITA would be effective for a period of five years, and, if issued as proposed, would authorize Level A and Level B harassment as the only type of take of ESA listed marine mammal species expected to result from activities during the construction phase of the project, with Level A take limited to only fin and sei whales. Section 3(18) of the Marine Mammal Protection Act defines ‘‘harassment’’ as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment). It is important to note that the MMPA definition of harassment is not the same as the ESA definition. This issue is discussed in further detail in the *Effects of the Action* section of this Opinion.

Take Proposed for Authorization under the MMPA
The methodology for estimating marine mammal exposure and incidental take is described fully in the Notice of Proposed ITA and discussed further in the *Effects of the Action*. For the purposes of the proposed ITA, NMFS OPR estimated the amount of take by considering: (1) acoustic thresholds above which NMFS OPR determined the best available scientific information indicates marine mammals will be behaviorally harassed (Level B) or incur some degree of permanent hearing impairment (Level A); (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) the number of days of activities. NMFS OPR is proposing to authorize MMPA take of ESA listed marine mammals resulting from noise exposure from vibratory installation and removal of cofferdams, impact pile driving for foundation installation, and HRG surveys.

Installation of Foundation Piles with Impact Hammer
As described in the Notice of Proposed ITA, modeling has been completed to estimate the sound fields associated with a number of noise producing activities and to estimate the number of individuals likely to be exposed to noise above identified thresholds. Table 3.10 show the proposed Level A and Level B take proposed to be authorized as a result of incidental take caused by impact pile driving assuming 10 dB attenuation (as required by conditions of the proposed ITA).

Table 3.10. MMPA Take of ESA Listed Species by Level A and B Harassment Proposed for Authorization through the MMPA ITA Resulting from Impact Pile Driving

Species	Level A Harassment	Level B Harassment
Fin whale	8	21
North Atlantic right whale	0	12
Sei whale	3	9
Sperm whale	0	6

source: Information in 88 FR 65430 (table 19) and modification provided by NMFS OPR during the consultation period (due to identified mathematical error in the proposed rule)

Cable Landfall Activities
As described in the Notice of Proposed ITA, modeling was carried out to estimate noise and exposure of marine mammals to noise above the Level A and Level B harassment thresholds during installation and removal of 8 cofferdams (4 at each landfall location). Table 3.11 shows the amount of take (Level A (none) and Level B harassment) that NMFS OPR is proposing to authorize resulting from the vibratory pile driving associated with the cable landfall.

Table 3.11. MMPA Take of ESA Listed Species by Level B Harassment Proposed for Authorization through the MMPA ITA from the Pile Driving Associated with the Cable Landfall

Species	Level B Harassment
Fin whale	7
North Atlantic right whale	8
Sei whale	6
Sperm whale	4

source: Information in 88 FR 65430 (table 21; Atlantic City and Monmouth combined)

HRG Surveys
The Notice of Proposed ITA includes a description of the modeling used to predict the amount of incidental take proposed for authorization under the MMPA. The amount of Level B harassment take proposed for authorization by NMFS OPR is illustrated in Table 3.12.

Table 3.12. MMPA Take of ESA Listed Species by Level B Harassment Proposed for Authorization through the MMPA ITA Resulting from High-Resolution Geophysical Surveys

Species	Level B Harassment
Fin whale	10
North Atlantic right whale	5
Sei whale	10
Sperm whale	5

source: 88 FR 65430 (table 23, annual proposed take multiplied by 5 to account for the 5 years of the proposed LOA)

3.9.2 Mitigation Measures Included in the Proposed ITA

The proposed ITA includes a number of minimization and monitoring methods that are designed to ensure that the proposed project has the least practicable adverse impact upon the affected species or stocks and their habitat and would be required to be implemented by Atlantic Shores. The proposed ITA, inclusive of the proposed mitigation requirements, has been published in the FR (88 FR 65430). The proposed mitigation measures include seasonal restrictions on timing for pile driving, establishment of minimum visibility and clearance zones for pile driving and some HRG surveys, shutdown measures, soft start of pile driving, ramp up of HRG sources, noise mitigation for impact pile driving, and vessel strike avoidance measures. For the purposes of this section 7 consultation, as noted, all minimization and monitoring measures included in the ITA proposed by NMFS OPR are considered as part of the proposed action for this consultation. We note that some of the measures identified here overlap or are duplicative with the measures described by BOEM in the BA as part of the proposed action (Appendix A as referenced above). The mitigation measures included in the September 2023 Proposed ITA are listed in Appendix B.

3.10 Action Area

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Effects of the action "are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action."

The action area includes the WDA where construction, operations and maintenance, and decommissioning activities will occur and the surrounding areas ensonified by noise from project activities; the cable corridors; and the areas where HRG and biological resource surveys will take place. Additionally, the action area includes the U.S. EEZ along the Atlantic and Gulf coasts between Monmouth, NJ and Corpus Christi, TX and the vessel transit routes to the identified ports in NJ (inclusive of the Delaware River), VA, and TX.

4.0 SPECIES AND CRITICAL HABITAT NOT CONSIDERED FURTHER IN THIS OPINION

In the BA, BOEM concludes that the proposed action may affect but is not likely to adversely affect blue whales, Rice's whales, giant manta rays, hawksbill sea turtles, or gulf sturgeon. BOEM concludes that the proposed action will have no effect on oceanic whitetip sharks, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, or any species of ESA listed corals. BOEM also concludes that the proposed action will have no effect on critical habitat designated for North Atlantic right whales, the Northwest Atlantic DPS of loggerhead sea turtles, the New York Bight DPS of Atlantic sturgeon, or elkhorn or staghorn corals. As explained below, we have determined that the project will have no effect on the Gulf of Maine DPS of Atlantic salmon or critical habitat designated for the North Atlantic right whale, or the Northwest Atlantic DPS of loggerhead sea turtles. We concur with BOEM's determination that the proposed action is not likely to adversely affect blue whales, Rice's whales, giant manta rays, hawksbill sea turtles, or gulf sturgeon; we conclude consultation informally for these species and critical habitat designations. We also agree with BOEM's determinations that the proposed action will have no effect on oceanic whitetip sharks, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, any species of ESA listed corals, or critical habitat designated for North Atlantic right whales, the Northwest Atlantic DPS of loggerhead sea turtles, or elkhorn or staghorn corals. Effects to critical habitat designated for the New York Bight DPS of Atlantic sturgeon are addressed in section 6 and 7 of this opinion.

4.1 ESA Listed Species

Blue whales (Balaenoptera musculus) – Endangered

In the North Atlantic Ocean, the range of blue whales extends from the subtropics to the Greenland Sea. As described in Hayes et al. (2020; the most recent stock assessment report), blue whales have been detected and tracked acoustically in much of the North Atlantic with most of the acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles. Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, Newfoundland, Nova Scotia, New England, and Greenland all belong to the same stock, while blue whales photographed off Iceland and the Azores appear to be part of a separate population (CETAP 1982; Wenzel et al. 1988; Sears and Calambokidis 2002; Sears and Larsen 2002). The largest concentrations of blue whales are found in the lower St. Lawrence Estuary (LeSage et al. 2017, Comtois et al. 2010) which is outside of the action area. Blue whales do not regularly occur within the U.S. EEZ and typically occur further offshore in areas with depths of 100 m or more (Waring et al. 2010).

Migration patterns for blue whales in the eastern North Atlantic Ocean are poorly understood. However, blue whales have been documented in winter months off Mauritania in northwest Africa (Baines & Reichelt 2014); in the Azores, where their arrival is linked to secondary production generated by the North Atlantic spring phytoplankton bloom (Visser et al. 2011); and traveling through deep-water areas near the shelf break west of the British Isles (Charif & Clark 2009). Blue whale calls have been detected in winter on hydrophones along the mid-Atlantic ridge south of the Azores (Nieukirk et al. 2004).

Blue whales have not been documented in the WDA[11] and are not expected to occur in the WDA and are not expected to occur along any of the vessel transit routes described in BOEM's BA. A single blue whale was acoustically tracked by Muirhead et al. (2018) in the New York Bight, and shown to be on the edge of the continental shelf, well offshore and north of the WDA. During aerial line-transect surveys in the New York Bight from 2017 to 2020, Zoidis et al. (2021) observed blue whales 3 times: 2 groups totaling 4 individuals sighted in the plain zone in winter (in January and February) of Year 1, and a single individual in the fall (September) seen on the slope in Year 3. Estabrook et al (2021) reported results from three years of acoustic surveys of large whales in the New York Bight; blue whales were rarely detected and only on the furthest offshore acoustic receivers. The authors concluded that at least some of the detections were likely from whales located outside the New York Bight beyond the shelf edge. These results were consistent with a similar 2008-2009 survey (Muirhead et al. 2018, Davis et al. 2020). The

[11] Available sightings data at: http://seamap.env.duke.edu/species/180528. Last accessed October 14, 2023.

small number of days with detections suggests blue whales do not spend much time in the offshore waters of the NY Bight, and instead are likely migrating through the area (Estabrook et al. 2021). All of these detections were north and offshore of the Atlantic Shores lease area and outside of the action area.

The rarity of observations in this area is consistent with the conclusion in Waring et al. (2010) that the blue whale is best considered as an occasional visitor in U.S. Atlantic EEZ waters and would be rare in the vicinity of the WDA. Therefore, based on the best available information cited herein, which supports a conclusion that blue whales are extremely unlikely to occur in the WDA, we conclude that blue whales are extremely unlikely to be exposed to any effects of project activities in the action area; therefore, effects of those activities, including construction, operations, and decommissioning, inclusive of associated surveys, are discountable. No take is anticipated.

Rice's whale (Balaenoptera ricei) – Endangered
On August 23, 2021, NMFS issued a direct final rule to revise the common and scientific name of the Gulf of Mexico Bryde's whale to Rice's whale, *Balaneoptera ricei*, and classification to species to reflect the scientifically accepted taxonomy and nomenclature of the whales (86 FR 47022). The distribution of Rice's whale is limited to the northeastern Gulf of Mexico, along the continental shelf break between 100 m and 400 m depths (Rosel et al. 2016). The only project-related activity that has the potential to overlap with the species distribution are vessel transits between the WDA and Corpus Christi, TX. We have considered whether vessels transiting to and from the project area from ports in the Gulf of Mexico could potentially encounter Rice's whales. BOEM estimates up to 20 trips between Corpus Christi and the WDA during the construction period and up to another 20 trips during the decommissioning period. As noted in the BA, project vessels will avoid Rice's whale Core Distribution Area and seek to avoid the extended habitat area where Rice's whales are expected to occur. The proposed action includes a number of measures for any project vessels operating in the Gulf of Mexico (see Table 1-11 in BOEM's BA and Appendix A of this Opinion). Based on the vessel transit routes, which are anticipated to be south and west of the distribution of Rice's whales, it is extremely unlikely that any Rice's whales will co-occur with project vessels; implementation of the vessel strike avoidance measures that are part of the proposed action further reduce the potential for any effects to Rice's whales. As such, effects to Rice's whales are extremely unlikely to occur. No take is anticipated. As all effects will be discountable, the proposed action is not likely to adversely affect the Rice's whale.

Giant Manta Ray (Manta birostris) – Threatened
The giant manta ray inhabits temperate, tropical, and subtropical waters worldwide, primarily between 35° N and 35° S latitudes. In the western Atlantic Ocean, this includes waters off South Carolina south to Brazil and Bermuda. Giant manta rays also occur in the Gulf of Mexico. On the U.S. Atlantic coast, nearshore distribution is limited to areas off the Florida coast; otherwise, distribution occurs in offshore waters at the shelf edge. Occasionally, manta rays are observed as far north as Long Island (Miller and Klimovich 2017, Farmer et al. 2021); however, these sightings are in offshore waters along the continental shelf edge and the species is considered rare in waters north of Cape Hatteras. As described in section 3.4, the action area includes: the lease area (OCS-A 0499) and the surrounding areas ensonified by proposed Project noise; the

offshore export cable route corridors; the areas within the lease and along the cable corridors where HRG, fisheries, and biological resource surveys will take place; the vessel transit areas between the lease area and ports in New Jersey, Virginia, and Gulf of Mexico. Distribution of Giant manta rays is limited by their thermal tolerance (19-22°C off the U.S. Atlantic coast) and influenced by depth. As noted by Farmer et al. (2021), cold winter air and sea surface temperatures in the western North Atlantic Ocean likely create a physiological barrier to manta rays that restricts the northern boundary of their distribution. Giant manta rays frequently feed in waters at depths of 656 to 1,312 feet (200 to 400 meters) (NMFS 2019a); the only portion of the action area with these depths is along the vessel transit routes south of the lease area. Based on the documented distribution of the species, Giant manta rays are not anticipated to occur in the lease area, in areas that will experience project noise, in areas where surveys will occur, or along the cable routes. The only portion of the action area that overlaps with the distribution of Giant manta rays are the vessel transit routes south of Delaware Bay (i.e., to/from Portsmouth Marine Terminal, Virginia, and Corpus Christi, Texas). As described below, surveys in and near the lease area support this determination.

From 2003-2008, trawl surveys off the coast of New Jersey, inclusive of the Atlantic Shores South lease area, the area where increased noise will be experienced, and the cable corridors, were carried out to collect fish and fisheries information for the New Jersey Department of Environmental Protection (NJDEP) Ocean/Wind Power Ecological Baseline Studies. During this time 1,120 trawl tows were completed and no giant manta rays were reported (GeoMarine 2010, Volume IV). In this same area, ancillary fish observations were collected during the ship surveys from January 2008 to December 2009 and from the aerial surveys from January to June 2009; four unidentified rays were reported during those surveys (GeoMarine 2010, Volume IV). All sightings were several miles south and/or east of the lease area and the area that will experience project noise. Farmer et al. (2021) summarized results of NYSERDA surveys carried out from nearshore to offshore marine environments of New York, with temporal coverage during the spring/summer of 2016–2019 and fall/winter of 2016–2018 (NYSERDA 2021). The area surveyed extended from the south coast of Long Island southeast to the continental shelf break. Of the 21,539 rays identified in the surveys, 7 were manta rays. Farmer et al. (2021) reports that despite comprehensive coast to shelf survey coverage, manta ray sightings were exclusively in August on the continental shelf edge.

Based on the documented distribution of Giant manta rays, the only project activity that individuals could be exposed to are vessels traveling to/from ports in Virginia and the Gulf of Mexico (with exposure limited to the portion of the trips that are south of Delaware Bay). Here, we consider the potential for effects of project vessels on giant manta rays. Giant manta rays can be frequently observed traveling just below the surface and will often approach or show little fear toward humans or vessels (Coles 1916), which may also make them vulnerable to vessel strikes (Deakos 2010); vessel strikes can injure or kill giant manta rays, decreasing fitness or contributing to non-natural mortality (Couturier et al. 2012; Deakos et al. 2011); however, vessel strikes are considered rare. Information about interactions between vessels and giant manta rays is limited. We have at least some reports of vessel strike, including a report of five giant manta rays struck by vessels from 2016 through 2018; individuals had injuries (i.e., fresh or healed dorsal surface propeller scars) consistent with a vessel strike. These interactions were observed by researchers conducting surveys from Boynton Beach to Jupiter, Florida (J. Pate, Florida

Manta Project, pers. comm. to M. Miller, NMFS OPR, 2018) and it is unknown where the manta was at the time of the vessel strike. The geographic area considered to have the highest risk of vessel strikes for giant manta ray is nearshore coastal waters and inlets along the east coast of Florida where recreational vessel traffic is concentrated; this area does not overlap with the action area. Given the few instances of confirmed or suspected strandings of giant manta rays attributed to vessel strike injury, the risk of giant manta rays being struck by vessels is considered low. This lack of documented mortalities could also be the result of other factors that influence carcass detection (i.e., wind, currents, scavenging, decomposition etc.); however, giant manta rays appear to be able to be fast and agile enough to avoid most moving vessels, as anecdotally evidenced by videos showing rays avoiding interactions with high-speed vessels (Barnette 2018).

The speed and maneuverability of giant manta rays, the slow operating speed of project vessels transiting through the portion of the action area where Giant manta rays occur, and the dispersed nature of Giant manta ray distribution in the open ocean area where these vessels will operate, and the small number of potential vessel trips through the range of Giant manta rays (limited to just those vessels transiting between the Atlantic Shores WDA and the Port of Portsmouth, VA or Corpus Christi, TX) make any effects of the proposed action extremely unlikely to occur. No effects from potential exposure to vessel noise are anticipated. No take is anticipated. As all effects of the proposed action will be discountable, the proposed action is not likely to adversely affect the giant manta ray.

Hawksbill sea turtle (Eretmochelys imbricate) – Endangered

The hawksbill sea turtle is typically found in tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans, including the coral reef habitats of the Caribbean and Central America. Hawksbill turtles generally do not migrate north of Florida and their presence north of Florida is rare (NMFS and USFWS 1993). No sightings of Hawksbill turtles have been documented within Atlantic coastal waters off New Jersey (CWFNJ 2021), and they were not observed in the New Jersey Department of Environmental Protection's (NJDEP's) Ocean/Wind Power Ecological Baseline Studies (NJDEP 2010), which includes the lease area. Two sightings of one individual each occurred during the Atlantic Marine Assessment Program for Protected Species (AMAPPS) study in 2019 off central Florida, but no sightings in the action area were recorded prior to 2019 or since (Palka et al. 2017; NEFSC and SEFSC 2020, 2021).

Given their rarity in waters north of Florida, hawksbill sea turtles are highly unlikely to occur in the WDA. The presence of hawksbill sea turtles in the action area is limited to the portion of the action area in the Gulf of Mexico and off the Florida coast that may be transited by project vessels. As noted in section 3.0, use of this area is expected to be limited to up to 20 vessel trips during the four year construction period and up to 20 trips during the decommissioning period. However, given the low numbers and dispersed nature of hawksbills in the areas where vessels will transit, the small number of vessel trips (up to 40 over a multi-year period), it is extremely unlikely that any hawksbill sea turtles will co-occur with project vessels. As such, effects to hawksbill sea turtles from vessel operations are also extremely unlikely to occur. No take is anticipated. As all effects of the proposed action will be discountable, the proposed action is not likely to adversely affect the hawksbill sea turtle.

Gulf Sturgeon (Acipenser oxyrinchus desotoi) – Threatened

The Gulf sturgeon is a sub-species of the Atlantic sturgeon that can be found from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi to the Suwannee River in Florida (USFWS and NMFS 2009). Historically the species ranged from the Mississippi River east to Tampa Bay. Gulf sturgeon spawn in rivers in the spring and fall and spend the summer months between the upstream spawning areas and the estuary. In the winter, adults will move into marine waters but younger fish remain in the estuarine and freshwater habitats for their first few years.

The only portion of the action area that could potentially overlap with the range of Gulf sturgeon are the vessel transit routes to and from Gulf of Mexico ports. The few vessels trips to/from the Gulf of Mexico (up to 40 over the multi-year construction and decommissioning periods) are anticipated to occur between the Atlantic Shores WDA and Corpus Christi, TX. The distribution of Gulf sturgeon within the Gulf of Mexico is limited to the northeastern areas of the Gulf. Vessels transiting between the WDA and Corpus Christi are not expected to transit the portion of the Gulf of Mexico where Gulf sturgeon occur. As such, we do not expect any effects on Gulf sturgeon caused by project vessels. The proposed action will have no effect on Gulf sturgeon.

Oceanic White Tip Shark (Carcharhinus longimanus) – Threatened

The oceanic whitetip shark is usually found offshore in deep waters of the open ocean, on the outer continental shelf, or around oceanic islands in deep water greater than 184 m. As noted in Young et al. 2017, the species has a clear preference for open ocean waters between 10°N and 10°S, but can be found in decreasing numbers out to latitudes of 30°N and 35°S, with abundance decreasing with greater proximity to continental shelves. In the western Atlantic, oceanic whitetips occur from Maine to Argentina, including the Caribbean and Gulf of Mexico (Young et al. 2017). In the central and eastern Atlantic, the species occurs from Madeira, Portugal south to the Gulf of Guinea, and possibly in the Mediterranean Sea.

The lease area and cable corridors, as well as the area where noise from project construction, operation, and decommissioning, and where survey activities will occur is outside of the deep offshore areas where Oceanic whitetip sharks occur. Vessel strikes are not identified as a threat in the status review (Young et al., 2017), listing determination (83 FR 4153) or the recovery outline (NMFS 2018). We have no information to suggest that vessels in the ocean have any effects on oceanic white tip sharks. Considering the lack of any reported vessel strikes, their swim speed and maneuverability (Papastamatiou et al. 2017), and the slow speed of ocean-going vessels, vessel strikes are extremely unlikely even if migrating individuals occur along the vessel transit routes. No effects from potential exposure to vessel noise are anticipated. No take is anticipated. As all effects of the proposed action will be discountable, the proposed action is not likely to adversely affect the oceanic white tip shark.

Gulf of Maine DPS of Atlantic salmon (Salmo salar) – Endangered

The only remaining populations of Gulf of Maine DPS Atlantic salmon are in Maine. Smolts migrate from their natal rivers in Maine north to foraging grounds in the Western North Atlantic off Canada and Greenland (Fay et al. 2006). After one or more winters at sea, adults return to their natal river to spawn. Atlantic salmon do not occur in the action area. The proposed action will have no effect on the Gulf of Maine DPS of Atlantic salmon.

Nassau Grouper (Epinephelus striatus) – Threatened
Nassau grouper are reef fish found in tropical and subtropical waters of the western North Atlantic. This includes Bermuda, Florida, Bahamas, the Yucatan Peninsula, and throughout the Caribbean to southern Brazil. There has been one verified report of Nassau grouper in the Gulf of Mexico at Flower Gardens Bank. They generally live among shallow reefs, but can be found in depths to 426 ft. (NMFS 2013). The range of Nassau grouper is described as including the southeastern portion of the Gulf of Mexico between the Florida coast and the Yucatan Peninsula (NMFS 2013). As described in NMFS 2013, the Nassau grouper is considered a reef fish, but it transitions through a series of ontogenetic shifts of both habitat and diet. As larvae, they are planktonic; as juveniles, they are found in nearshore shallow waters in macroalgal and seagrass habitats. They shift progressively deeper with increasing size and maturation into predominantly reef habitat (e.g., forereef and reef crest). Adult Nassau grouper tend to be relatively sedentary and are found most abundantly on high relief coral reefs or rocky substrate in clear waters (Sadovy and Eklund 1999 in NMFS 2013), although they can be found from the shoreline to about 100-130 m. Larger adults tend to occupy deeper, more rugose, reef areas (Semmens et al. 2007a in NMFS 2013).

Overlap with the range of Nassau grouper and the action area is limited to the portion of the action area where vessels transiting between the WDA and Corpus Christi would move through the southeastern portion of the Gulf of Mexico into the Atlantic Ocean. Given the primary distribution of Nassau grouper over reef habitats, which will be avoided by the transiting vessels, there is a low potential for occurrence of Nassau grouper in the areas where vessels will transit. Further, the near-bottom distribution of Nassau grouper in the water column makes it extremely unlikely that there would be any interactions with any project vessels. Vessel strikes are not identified as a threat in the biological report that supported the listing determination (NMFS 2013), listing determination (81 FR 42268), or the recovery outline (NMFS 2018). We have no information to suggest that vessels in the ocean have any effects on Nassau grouper. Therefore, we do not expect any effects to this species even if individuals co-occur with project vessels. The proposed action will have no effect on Nassau grouper.

Scalloped Hammerhead Shark (Sphyrna lewini) – Southwest Atlantic DPS, Threatened
Miller et al. (2014) describe the scalloped hammerhead shark as a circumglobal species that lives in coastal warm temperate and tropical seas. It occurs over continental and insular shelves, as well as adjacent deep waters. Scalloped hammerhead sharks are highly mobile and partly migratory, making migrations along continental margins as well as between oceanic islands in tropical waters. While scalloped hammerheads occur in the Northwest Atlantic and Gulf of Mexico, those individuals are part of DPSs that are not listed under the ESA (79 FR 38214, July 3, 2014). The Southwest Atlantic DPS of scalloped hammerheads is listed as threatened under the ESA; however, as noted in BOEM’s BA, its range does not overlap with the action area. As such, no ESA listed scalloped hammerhead sharks are expected to be exposed to any effects of the proposed action. The proposed action will have no effect on the Southwest Atlantic DPS of scalloped hammerhead shark.

Smalltooth Sawfish (Pristis pectinate) – Endangered
Smalltooth sawfish live in shallow, coastal waters of tropical seas and estuaries of the Atlantic Ocean and sometimes enter the lower reaches of tropical freshwater river systems. The historical range for smalltooth sawfish in the western Atlantic extended from Brazil to the Gulf of Mexico and eastern seaboard of the U.S. (Carlson et al. 2013 in NMFS 2018). However, the species has been wholly or nearly extirpated from large areas of its historical range, and in U.S. waters smalltooth sawfish are now found only off the coast of Florida (NMFS 2018). Small, juvenile smalltooth sawfish are generally restricted to mangroves and estuaries around the Florida peninsula, where project vessels will not travel. Larger adults have a broader distribution and could be found in the southeastern Gulf of Mexico in nearshore waters along the Florida shoreline. Given the distribution of the species in nearshore waters, the occurrence of smalltooth sawfish along the deepwater areas that will be used by project vessels to transit between the WDA and Corpus Christi, TX is extremely unlikely. Vessel strikes are not identified as a threat in the listing determination (68 FR 15674), the most-recent 5-year review (NMFS 2018), or the recovery plan (NMFS 2009). We have no information to suggest that vessels in the ocean have any effects on smalltooth sawfish. Therefore, we do not expect any effects to this species even if individuals unexpectedly occurred along the vessel transit routes to be traveled by project vessels. The proposed action will have no effect on smalltooth sawfish.

ESA Listed Corals – Threatened and Endangered
There are six species of corals protected under the ESA that occur in the action area: Elkhorn coral (*Acropora palmata*); Staghorn coral (*Acropora cervicornis*); Boulder star coral (*Orbicella franksi*); Mountainous star coral (*Orbicella faveolata*); Lobed star coral (*Orbicella annularis*); Rough cactus coral (*Mycetophyllia ferox*); and Pillar coral (*Dendrogyra cylindrus*) (79 FR 53851). The only activity that overlaps with the distribution of these species are vessel transits to/from ports in the Gulf of Mexico, including transits along the U.S. South Atlantic coast. Transit routes for project vessels may co-occur with coral habitats, however, no impacts to corals are anticipated along vessel transit routes as water depths exclude the potential for vessel hulls and propellers to interact with the sessile species, and no anchoring will occur in areas where corals could be present. No effects to any of these coral species are anticipated; the proposed action will have no effect on any species of ESA listed corals.

4.2 Critical Habitat

Critical Habitat Designated for North Atlantic right whales
On January 27, 2016, NMFS issued a final rule designating critical habitat for North Atlantic right whales (81 FR 4837). Critical habitat includes two areas (Units) located in the Gulf of Maine and Georges Bank Region (Unit 1) and off the coast of North Carolina, South Carolina, Georgia and Florida (Unit 2). The action area does not overlap with Unit 1. Project vessels transiting to/from ports in the Gulf of Mexico may transit through Unit 2. No other effects of the project will extend to Unit 2. As explained below, we have determined that the proposed project will have no effect on critical habitat designated for North Atlantic right whales.

Consideration of Potential Effects to Unit 1
There are no project activities that overlap with Unit 1. Here, we explain our consideration of whether any project activities located outside of Unit 1 may affect Unit 1. As identified in the

final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale that provide foraging area functions in Unit 1 are: The physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *C. finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.

We have considered whether the proposed action would have any effects to right whale critical habitat. Copepods in critical habitat originate from Jordan, Wilkinson, and George's Basin. The effects of the proposed action do not extend to these areas, and we do not expect any effects to the generation of copepods in these areas that could be attributable to the proposed action. The proposed action will also not affect any of the physical or oceanographic conditions that serve to aggregate copepods in critical habitat. Offshore wind farms can reduce wind speed and wind stress which can lead to less mixing, lower current speeds, and higher surface water temperature (Afsharian et al. 2019), cause wakes that will result in detectable changes in vertical motion and/or structure in the water column (e.g. Christiansen & Hasager 2005, Broström 2008), as well as detectable wakes downstream from a wind farm by increased turbidity (Vanhellemont and Ruddick, 2014). However, there is no information to suggest that effects from the Atlantic Shores project would extend to Unit 1. The Atlantic Shores project is a significant distance from right whale critical habitat and, thus, it is not anticipated to affect the oceanographic features of that critical habitat. Further, the Atlantic Shores project is not anticipated to cause changes to the physical or biological features of critical habitat by worsening climate change. Therefore, we have determined that the proposed action will have no effect on Unit 1 of right whale critical habitat.

Consideration of Potential Effects to Unit 2

As identified in the final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale, which provide calving area functions in Unit 2, are: (i) Sea surface conditions associated with Force 4 or less on the Beaufort Scale; (ii) Sea surface temperatures of 7 °C to 17 °C; and, (iii) Water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 nmi^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

Vessel transits will have no effect on the features of Unit 2; this is because vessel operations do not affect sea surface state, water temperature, or water depth. Therefore, we have determined that the proposed action will have no effect on Unit 2 of right whale critical habitat.

Critical Habitat for the Northwest Atlantic Ocean DPS of Loggerhead Sea Turtles
Critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtles was designated in 2014 (79 FR 39855). Specific areas for designation include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat types: Nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat. There is no critical habitat designated in the WDA. The only project activities that may overlap with Northwest Atlantic loggerhead DPS critical habitat are vessels transiting to or from the project site from Corpus Christ, TX. As explained below, the proposed action will have no effect on this critical habitat.

Nearshore Reproductive
The PBF of nearshore reproductive habitat is described as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season.

Primary Constituent Elements (PCEs) that support this habitat are the following: (1) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 17.95(c) to 1.6 km (1 mile) offshore; (2) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and, (3) Waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.

The occasional project vessel transits that may occur within the designated nearshore reproductive habitat will have no effect on nearshore reproductive habitat for the following reasons: waters would remain free of obstructions or artificial lighting that would affect the transit of turtles through the surf zone and outward toward open water; and, vessel transits would not promote predators or disrupt wave patterns necessary for orientation or create excessive longshore currents.

Winter
The PBF of winter habitat is described as warm water habitat south of Cape Hatteras, North Carolina near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. PCEs that support this habitat are the following: (1) Water temperatures above 10° C from November through April; (2) Continental shelf waters in proximity to the western boundary of the Gulf Stream; and, (3) Water depths between 20 and 100 m.

The occasional project vessel transits that may occur within the designated winter habitat will have no effect on this habitat because they will not: affect or change water temperatures above 10° C from November through April; affect habitat in continental shelf waters in proximity to the western boundary of the Gulf Stream; or, affect or change water depths between 20 and 100 m.

Breeding
The PBFs of concentrated breeding habitat are sites with high densities of both male and female adult individuals during the breeding season. PCEs that support this habitat are the following:

(1) High densities of reproductive male and female loggerheads; (2) Proximity to primary Florida migratory corridor; and, (3) Proximity to Florida nesting grounds.

The occasional project vessel transits that may occur within the designated breeding habitat will have no effect on this habitat because they will not: affect the density of reproductive male or female loggerheads or result in any alterations of habitat in proximity to the primary Florida migratory corridor or Florida nesting grounds.

Constricted Migratory Corridors
The PBF of constricted migratory habitat is high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. PCEs that support this habitat are the following: (1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and, (2) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.

The occasional project vessel transits that may occur within the designated winter habitat will have no effect on this habitat because they will not result in any alterations of habitat in the constricted continental shelf area and will not affect passage conditions in this area.

Sargassum
The PBF of loggerhead *Sargassum* habitat is developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially Sargassum. PCEs that support this habitat are the following: (i) Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the Sargassum community in water temperatures suitable for the optimal growth of Sargassum and inhabitance of loggerheads; (ii) Sargassum in concentrations that support adequate prey abundance and cover; (iii) Available prey and other material associated with Sargassum habitat including, but not limited to, plants and cyanobacteria and animals native to the Sargassum community such as hydroids and copepods; and, (iv) Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by Sargassum for post-hatchling loggerheads, i.e., >10 m depth.

The occasional project vessel transits that may occur within the designated *Sargassum* habitat will have no effect on: conditions that result in convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the Sargassum community in water temperatures suitable for the optimal growth of Sargassum and inhabitance of loggerheads; the concentration of Sargassum; the availability of prey within Sargassum; or the depth of water in any area.

Summary of Effects to Critical Habitat
We have determined that because the proposed action will have no effect on any of the PBFs, the proposed action will have no effect on the critical habitat designated for the Northwest Atlantic DPS of loggerhead sea turtles.

Critical Habitat for Elkhorn (Acropora palmate) and Staghorn (A. cervicornis) Corals
NMFS designated critical habitat for elkhorn and staghorn corals includes four specific areas: the Florida area, the Puerto Rico area, the St. John/St. Thomas area, and the St. Croix area (73 FR 72210, November 26, 2008. The Florida area encompasses approximately 1,329 square miles (3,442 square kilometers) of marine habitat and is within the action area; however, vessels transiting between the WDA and Corpus Christi, TX are not expected to transit through the area designated as critical habitat due to its shallow depths (i.e., critical habitat extends out to depths of 30 m). As described in the final listing rule, the physical and biological feature (PBF) essential to conservation of these species is substrate of suitable quality and availability (i.e., natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover) to support successful larval settlement and recruitment, and reattachment and recruitment of fragments. Even if project vessels did transit through areas designated as critical habitat, these vessel transits would not affect this PBF as no substrate-disturbing activities (e.g., anchoring) are expected in this portion of the action area. No effects to this critical habitat are anticipated as a result of the proposed action.

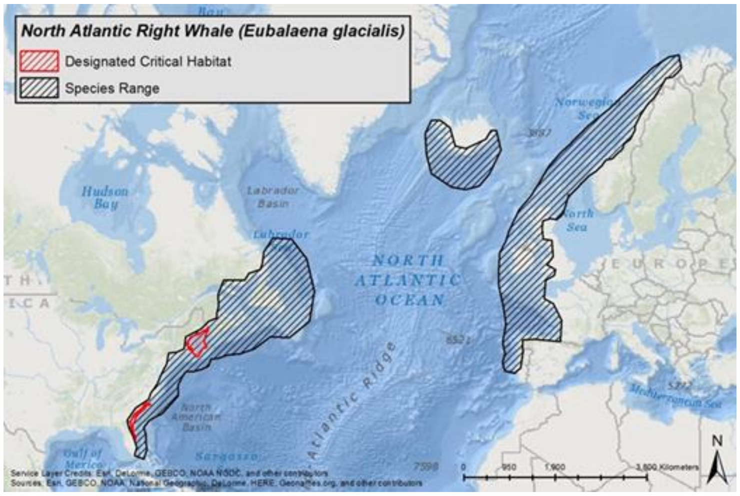
5.0 STATUS OF THE SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

5.1 Marine Mammals

5.1.1 North Atlantic Right Whale (Eubalaena glacialis)
There are three species classified as right whales (genus *Eubalaena*): North Pacific (*E. japonica*), Southern (*E. australis*), and North Atlantic (*E. glacialis*). The North Atlantic right whale is the only species of right whale that occurs in the North Atlantic Ocean (Figure 5.1.1) and, therefore, is the only species of right whale that may occur in the action area.

North Atlantic right whales occur primarily in the western North Atlantic Ocean. However, there have been acoustic detections, reports, and/or sightings of North Atlantic right whales in waters off Greenland (east/southeast), Newfoundland, northern Norway, and Iceland, as well as within Labrador Basin (Hamilton et al. 1998, Jacobsen et al. 2004, Knowlton et al. 1992, Mellinger et al. 2011). These latter sightings/detections are consistent with historic records documenting North Atlantic right whales south of Greenland, in the Denmark straits, and in eastern North Atlantic waters (Kraus et al. 2007). There is also evidence of possible historic North Atlantic right whale calving grounds in the Mediterranean Sea (Rodrigues et al. 2018), an area not currently considered as part of this species' historical range.

Figure 5.1.1. Approximate historic range and currently designated U.S. critical habitat of the North Atlantic right whale



The North Atlantic right whale is distinguished by its stocky body and lack of a dorsal fin. The species was listed as endangered on December 2, 1970. We used information available in the most recent five-year review for North Atlantic right whales (NMFS 2022), the most recent stock assessment reports (Hayes et al. 2022 and Hayes et al. 2023), and the scientific literature to summarize the status of the species, as follows.

Life History

The maximum lifespan of North Atlantic right whales is unknown, but one individual reached at least 70 years of age (Hamilton et al. 1998, Kenney 2009). Previous modeling efforts suggest that in 1980, females had a life expectancy of approximately 51.8 years of age, which was twice that of males at the time (Fujiwara and Caswell 2001); however, by 1995, female life expectancy was estimated to have declined to approximately 14.5 years (Fujiwara and Caswell 2001). Most recent estimates indicate that North Atlantic right whale females are only living to 45 and males to age 65 (https://www.fisheries.noaa.gov/species/north-atlantic-right-whale). Females, ages 5+, have reduced survival relative to males, ages 5+, resulting in a decrease in female abundance relative to male abundance (Pace et al. 2017). Specifically, state-space mark-recapture model estimates show that from 2010-2015, males declined just under 4.0%, and females declined approximately 7% (Pace et al. 2017).

Gestation is estimated to be between 12 and 14 months, after which calves typically nurse for around one year (Cole et al. 2013, Kenney 2009, Kraus and Hatch 2001, Lockyer 1984). After weaning a calf, females typically undergo a ‘resting’ period before becoming pregnant again, presumably because they need time to recover from the energy deficit experienced during lactation (Fortune et al. 2013, Fortune et al. 2012, Pettis et al. 2017a). From 1983 to 2005, annual average calving intervals ranged from 3 to 5.8 years (overall average of 4.23 years) (Kraus et al. 2007). Between 2006 and 2015, annual average calving intervals continued to vary within this range, but in 2016 and 2017 longer calving intervals were reported (6.3 to 6.6 years in 2016 and 10.2 years in 2017) (Hayes et al. 2018a, Pettis and Hamilton 2015, Pettis and Hamilton 2016, Pettis et al. 2018a, Pettis et al. 2018b, Pettis et al. 2020). There were no calves recorded in

2018. Annual average calving interval between 2019 and 2022 ranged from a low of 7 in 2019 to a high of 9.2 in 2021 (Pettis et al. 2022). The calving index is the annual percentage of reproductive females assumed alive and available to calve that was observed to produce a calf. This index averaged 47% from 2003 to 2010 but has dropped to an average of 17% since 2010 (Moore et al. 2021). The percentage of available females that had calves ranged from 11.9% to 30.5% from 2019-2022 (Pettis et al. 2022). Females have been known to give birth as young as five years old, but the mean age of a female first giving birth is 10.2 years old (n=76, range 5 to 23, SD 3.3) (Moore et al. 2021). Taken together, changes to inter-birth interval and age to first reproduction suggest that both parous (having given birth) and nulliparous (not having given birth) females are experiencing delays in calving. These calving delays correspond with the recent distribution shifts. The low reproductive rate of right whales is likely the result of several factors including nutrition (Fortune et al. 2013, Moore et al. 2021). Evidence also indicates that North Atlantic right whales are growing to shorter adult lengths than in earlier decades (Stewart et al. 2021) and are in poor body condition compared to southern right whales (Christiansen et al. 2020). As stated in Hayes et al. 2023, all these changes may result from a combination of documented regime shifts in primary feeding habitats (Meyer-Gutbrod and Greene 2014; Meyer-Gutbrod et al. 2021; Record et al. 2019), and increased energy expenditures related to non-lethal entanglements (Rolland et al. 2016; Pettis et al. 2017b; van der Hoop 2017). As noted in the 2022 Five-Year Review (NMFS 2022), poor body condition, arrested growth, and maternal body length have led to reduced reproductive success and are contributors to low birth rates for the population over the past decade (Christiansen et al. 2020; Reed et al. 2022; Stewart et al. 2021; Stewart et al. 2022).

Pregnant North Atlantic right whales migrate south, through the mid-Atlantic region of the U.S., to low latitudes during late fall where they overwinter and give birth in shallow, coastal waters (Kenney 2009, Krzystan et al. 2018). During spring, these females and new calves migrate to high latitude foraging grounds where they feed on large concentrations of copepods, primarily *C. finmarchicus* (Mayo et al. 2018, NMFS 2017). Some non-reproductive North Atlantic right whales (males, juveniles, non-reproducing females) also migrate south, although at more variable times throughout the winter. Others appear to not migrate south and remain in the northern feeding grounds year round or go elsewhere (Bort et al. 2015, Mayo et al. 2018, Morano et al. 2012, NMFS 2017, Stone et al. 2017). Nonetheless, calving females arrive to the southern calving grounds earlier and stay in the area more than twice as long as other demographics (Krzystan et al. 2018). Little is known about North Atlantic right whale habitat use in the mid-Atlantic, but recent acoustic data indicate near year round presence of at least some whales off the coasts of New Jersey, Virginia, and North Carolina (Davis et al. 2017, Hodge et al. 2015, Salisbury et al. 2016, Whitt et al. 2013). While it is generally not known where North Atlantic right whales mate, some evidence suggests that mating may occur in the northern feeding grounds (Cole et al. 2013, Matthews et al. 2014).

Population Dynamics

Today, North Atlantic right whales are primarily found in the western North Atlantic, from their calving grounds in lower latitudes off the coast of the southeastern United States to their feeding grounds in higher latitudes off the coast of New England and Nova Scotia (Hayes et al. 2018a). Beginning in 2010, a change in seasonal residency patterns has been documented through visual and acoustic monitoring with declines in presence in the Bay of Fundy, Gulf of Maine, and Great

South Channel, and more animals being observed in Cape Cod Bay, the Gulf of Saint Lawrence, the mid-Atlantic, and south of Nantucket, Massachusetts (Daoust et al. 2018, Davies et al. 2019, Davis et al. 2017, Hayes et al. 2018a, Hayes et al. 2019, Meyer-Gutbrod et al. 2018, Moore et al. 2021, Pace et al. 2017, Quintana-Rizzo et al. 2021). Right whales have been observed nearly year round in the area south of Martha's Vineyard and Nantucket, with highest sightings rates between December and May (Leiter et al., 2017, Stone et al. 2017, Quintana-Rizzo et al. 2021, O'Brien et al. 2022). Increased detections of right whales in the Gulf of St. Lawrence have been documented from late spring through the fall (Cole et al. 2016, Simard et al. 2019, DFO 2020).

There are two recognized populations of North Atlantic right whales, an eastern, and a western population. Very few individuals likely make up the population in the eastern Atlantic, which is thought to be functionally extinct (Best et al. 2001). However, in recent years, a few known individuals from the western population have been seen in the eastern Atlantic, suggesting some individuals may have wider ranges than previously thought (Kenney 2009). Specifically, there have been acoustic detections, reports, and/or sightings of North Atlantic right whales in waters off Greenland (east/southeast), Newfoundland, northern Norway, and Iceland, as well as within Labrador Basin (Jacobsen et al. 2004, Knowlton et al. 1992, Mellinger et al. 2011). It is estimated that the North Atlantic historically (i.e., pre-whaling) supported between 9,000 and 21,000 right whales (Monsarrat et al. 2016). The western population may have numbered fewer than 100 individuals by 1935, when international protection for right whales came into effect (Kenney et al. 1995).

Genetic analyses, based upon mitochondrial and nuclear DNA analyses, have consistently revealed an extremely low level of genetic diversity in the North Atlantic right whale population (Hayes et al. 2018a, Malik et al. 2000, McLeod and White 2010, Schaeff et al. 1997). Waldick et al. (2002) concluded that the principal loss of genetic diversity occurred prior to the 18th century, with more recent studies hypothesizing that the loss of genetic diversity may have occurred prior to the onset of Basque whaling during the 16th and 17th century (Mcleod et al. 2008, Rastogi et al. 2004, Reeves et al. 2007, Waldick et al. 2002). The persistence of low genetic diversity in the North Atlantic right whale population might indicate inbreeding; however, based on available data, no definitive conclusions can be reached at this time (Hayes et al. 2019, Radvan 2019, Schaeff et al. 1997). By combining 25 years of field data (1980-2005) with high-resolution genetic data, Frasier et al. (2013) found that North Atlantic right whale calves born between 1980 and 2005 had higher levels of microsatellite (nuclear) heterozygosity than would be expected from this species' gene pool. The authors concluded that this level of heterozygosity is due to postcopulatory selection of genetically dissimilar gametes and that this mechanism is a natural means to mitigate the loss of genetic diversity, over time, in small populations (Frasier et al. 2013).

In the western North Atlantic, North Atlantic right whale abundance was estimated to be 270 animals in 1990 (Pace et al. 2017). From 1990 to 2011, right whale abundance increased by approximately 2.8% per year, despite a decline in 1993 and no growth between 1997 and 2000 (Pace et al. 2017). However, since 2011, when the abundance peaked at 481 animals, the population has been in decline, with a 99.99% probability of a decline of just under 1% per year (Pace et al. 2017). Between 1990 and 2015, survival rates appeared relatively stable, but differed between the sexes, with males having higher survivorship than females (males: 0.985 ± 0.0038;

females: 0.968 ± 0.0073) leading to a male-biased sex ratio (approximately 1.46 males per female) (Pace et al. 2017).

As reported in the most recent final SAR (Hayes et al. 2023), the western North Atlantic right whale stock size is estimated based on a published state-space model of the sighting histories of individual whales identified using photo-identification techniques (Pace et al. 2017; Pace 2021). Sightings histories were constructed from the photo-ID recapture database as it existed in December 2021, and included photographic information up through November 2020. Using a hierarchical, state-space Bayesian open population model of these histories produced a median abundance value (N_{est}) as of November 30, 2020 of 338 individuals (95% Credible Interval (CI): 325–350). The minimum population estimate included in the most recent SAR is 332 (Hayes et al. 2023). Linden 2023[12] updates the population size estimate of North Atlantic right whales at the beginning of 2022 using the most recent year of available sightings data (collected through December 2022) and the existing modeling approach. Using the established capture-recapture framework (Pace et al. 2017), the estimated population size in 2022 was 356 whales, with a 95% credible interval ranging from 346 to 363. Linden notes that given uncertainty in the accuracy of the terminal year estimate (Pace 2021), interpretations should focus on the multi-year population trend. The sharp decrease observed from 2015-2020 appears to have slowed, though the right whale population continues to experience annual mortalities above recovery thresholds.

Each year, scientists at NMFS' Northeast Fisheries Science Center estimate the right whale population abundance and share that estimate at the North Atlantic Right Whale Consortium's annual meeting in a "Report Card." This estimate is considered preliminary and undergoes further review before being included in the draft North Atlantic Right Whale Stock Assessment Report. Each draft stock assessment report is peer-reviewed by one of three regional Scientific Review Groups, revised after a public comment period, and published. The 2022 "Report Card" (Pettis et al. 2022) data reports a preliminary population estimate for 2021 using data as of August 30, 2022 is 340 (+/- 7). Pettis et al. (2022) also report that fifteen mother calf pairs were sighted in 2022, down from 18 in 2021. There were no first time mothers sighted in 2022. Initial analyses detected at least 16 new entanglements in 2022: five whales seen with gear and 11 with new scarring from entanglements. Additionally, there was one non-fatal vessel strike detected. No carcasses were detected. Of the 15 calves born in 2022, one is known to have died and another is thought likely to have died. During the 2022-2023 season, there were 11 mothers with associated calves and one newborn documented alone that was later found dead. As of December 15, 2023, the 2023 Report Card had not been published; in a press release issued following the 2023 Consortium meeting, the New England Aquarium stated, "The 2021 estimate was recalculated as 364 (+5/-4 for range of error)—primarily due to the 18 calves born in 2021, many of which were recently catalogued—and the 2022 estimate is 356 animals (+7/-10), suggesting the downward trajectory for the species could be slowing."[13] For the 2023-2024 calving season, through December 10, 2023, three mother-calf pairs have been documented to date; new calves are typically documented at least through January, thus this should not be considered as a complete estimate of 2024 calves.

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[12] Available at: https://www.fisheries.noaa.gov/s3/2023-10/TM314-508-0.pdf

[13] https://www.neaq.org/about-us/press-room/press-releases/2022-population-estimate-north-atlantic-right-whale/; Last accessed December 8, 2023.

In addition to finding an overall decline in the North Atlantic right whale population, Pace et al. (2017) also found that between 1990 and 2015, the survival of age 5+ females relative to 5+ males has been reduced; this has resulted in diverging trajectories for male and female abundance. Specifically, there was an estimated 142 males (95% CI=143-152) and 123 females (95% CI=116-128) in 1990; however, by 2015, model estimates show the species was comprised of 272 males (95% CI=261-282) and 186 females (95% CI=174-195; Pace et al. 2017). Calving rates also varied substantially between 1990 and 2015 (i.e., 0.3% to 9.5%), with low calving rates coinciding with three periods (1993-1995, 1998-2000, and 2012-2015) of decline or no growth (Pace et al. 2017). Using generalized linear models, Corkeron et al. (2018) found that between 1992 and 2016, North Atlantic right whale calf counts increased at a rate of 1.98% per year. Using the highest annual estimates of survival recorded over the time series from Pace et al. (2017), and an assumed calving interval of approximately four years, Corkeron et al. (2018) suggests that the North Atlantic right whale population could potentially increase at a rate of at least 4% per year if there was no anthropogenic mortality.[14] This rate is approximately twice that observed, and the analysis indicates that adult female mortality is the main factor influencing this rate (Corkeron et al. 2018). Right whale births remain significantly below what is expected and the average inter-birth interval remains high (Pettis et al. 2022). Additionally, there were no first-time mothers in 2022, underscoring recent research findings that fewer adult, nulliparous females are becoming reproductively active (Reed et al., 2022).

Status
The North Atlantic right whale is listed under the ESA as endangered. Anthropogenic mortality and sub-lethal stressors (i.e., entanglement) that affect reproductive success are currently affecting the ability of the species to recover (Corkeron et al. 2018, Stewart et al. 2021), currently, none of the species recovery goals (see below) have been met. With whaling now prohibited, the two major known human causes of mortality are vessel strikes and entanglement in fishing gear (Hayes et al. 2018a). Estimates of total annual anthropogenic mortality (i.e., ship strike and entanglement in fishing gear), as well as the number of undetected anthropogenic mortalities for North Atlantic right whales are presented in the annual stock assessment reports. These anthropogenic threats appear to be worsening (Hayes et al. 2018a).

On June 7, 2017, NMFS declared an Unusual Mortality Event (UME) for the North Atlantic right whale, as a result of 17 observed right whale mortalities in the U.S. and Canada. Under the Marine Mammal Protection Act, a UME is defined as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." As of December, 2023, there are 36 confirmed mortalities for the UME, 34 serious injuries, and 51 sublethal injuries or illness (for more information on UMEs, see https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-unusual-

[14] Based on information in the North Atlantic Right Whale Catalog, the mean calving interval is 4.69 years (P. Hamilton 2018, unpublished, in Corkeron et al. 2018). Corkeron et al. (2018) assumed a 4 year calving interval as the approximate mid-point between the North Atlantic Right Whale Catalog calving interval and observed calving intervals for southern right whales (i.e., 3.16 years for South Africa, 3.42 years for Argentina, 3.31 years for Auckland Islands, and 3.3 years for Australia).

mortality-events). Mortalities are recorded as vessel strike (12), entanglement (9), perinatal (2), unknown/undetermined (3), or not examined (10).[15]

The North Atlantic right whale population continues to decline. As noted above, between 1990 to 2011, right whale abundance increased by approximately 2.8% per year; however, since 2011 the population has been in decline (Pace et al. 2017). The 2023 SAR reports an overall abundance decline between 2011 and 2020 of 23.5% (CI=21.4% to 26.0%) (Hayes et al. 2023). Recent modeling efforts indicate that low female survival, a male biased sex ratio, and low calving success are contributing to the population's current decline (Pace et al. 2017). For instance, five new calves were documented in 2017 calving season, zero in 2018, and seven in 2019 (Pettis et al. 2018a, Pettis et al. 2018b, Pettis et al. 2020), these numbers of births are well below the number needed to compensate for expected mortalities. More recently, there were 10 calves in the 2020 calving season, 18 calves in 2021, and 15 in 2022. Two of the 2020 calves and one of the 2021 calves died or were seriously injured due to vessel strikes. Two additional calves were reported in the 2021 season, but were not seen as a mother/calf pair. One animal stranded dead with no evidence of human interaction and initial results suggest the calf died during birth or shortly thereafter. The second animal was an anecdotal report of a calf off the Canary Islands. Two calves in 2022 are suspected to have died, with the causes of death unknown. As noted above, 11 mother-calf pairs were sighted in the 2022-2023 calving season[16].

Long-term photographic identification data indicate new calves rarely go undetected (Kraus et al. 2007, Pace et al. 2017). While there are likely a multitude of factors involved, low calving has been linked to poor female health (Rolland et al. 2016) and reduced prey availability (Devine et al. 2017, Johnson et al. 2017, Meyer-Gutbrod and Green 2014, Meyer-Gutbrod and Greene 2018, Meyer-Gutbrod et al. 2018). A recent study comparing North Atlantic right whales to other right whale species found that juvenile, adult, and lactating female North Atlantic right whales all had lower body condition scores compared to the southern right whale populations, with lactating females showing the largest difference; however, North Atlantic right whale calves were in good condition (Christiansen et al. 2020). While some of the difference could be the result of genetic isolation and adaptations to local environmental conditions, the authors suggest that the magnitude indicates that North Atlantic right whale females are in poor condition, which could be suppressing their growth, survival, age of sexual maturation and calving rates. In addition, they conclude that the observed differences are most likely a result of differences in the exposure to anthropogenic factors (Christiansen et al. 2020). Furthermore, entanglement in fishing gear appears to have substantial health and energetic costs that affect both survival and reproduction (Hayes et al. 2018a, Hunt et al. 2016, Lysiak et al. 2018, Pettis et al. 2017, Robbins et al. 2015, Rolland et al. 2017, van der Hoop et al. 2017).

Kenney et al. (2018) projected that if all other known or suspected impacts (e.g., vessel strikes, calving declines, climate change, resource limitation, sublethal entanglement effects, disease, predation, and ocean noise) on the population remained the same between 1990 and 2016, and none of the observed fishery related mortality and serious injury occurred, the projected

[15] https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event; last accessed July 26, 2023

[16] https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2023

population in 2016 would be 12.2% higher (506 individuals). Furthermore, if the actual mortality resulting from fishing gear is double the observed rate (as estimated in Pace et al. 2017), eliminating all mortalities (observed and unobserved) could have resulted in a 2016 population increase of 24.6% (562 individuals) and possibly over 600 in 2018 (Kenney 2018).

Given the above information, North Atlantic right whales' resilience to future perturbations affecting health, reproduction, and survival is expected to be very low (Hayes et al. 2018a). The observed (and clearly biased low) human-caused mortality and serious injury was 8.1 right whales per year from 2016 through 2020 (5.7 fisheries entanglements/year, 2.4 vessel strikes/year; Hayes et al. 2023). Using the refined methods of Pace et al. (2021), the estimated annual rate of total mortality for the period 2015–2019 was 31.2 (non-calves), which is 4.1 times larger than the 7.7 total derived from reported mortality and serious injury for the same period (Hayes et al. 2022). Using a matrix population projection model, it is estimated that by 2029 the population will decline from 160 females to the 1990 estimate of 123 females if the current rate of decline is not altered (Hayes et al. 2018a).

Climate change poses a significant threat to the recovery of North Atlantic right whales. The information presented here is summarized from a more complete description of this threat in the 2022 5-Year Review (NMFS 2022). The documented shift in North Atlantic right whale summer habitat from the Gulf of Maine to waters further north in the Gulf of St. Lawrence in the early 2010s is considered to be related to an oceanographic regime shift in Gulf of Maine waters linked to a northward shift of the Gulf Stream which caused the availability of the primary North Atlantic right whale prey, the copepod *Calanus finmarchicus*, to decline locally, forcing North Atlantic right whales to forage in areas further north (Meyer-Gutbrod et al. 2021; Record et al. 2019; Sorochan et al. 2019). The shift of North Atlantic right whale distribution into waters further north also created policy challenges for the Canadian government, which had to implement new regulations in areas that were not protected because they were not documented as right whale habitat in the past (Davies and Brillant 2019; Meyer-Gutbrod et al. 2018; Record et al. 2019).

When prey availability is low, North Atlantic right whale calving rates decline, a well-documented phenomenon through periods of low prey availability in the 1990s and the 2010s; without increased prey availability in the future, low population growth is predicted (Meyer-Gutbrod and Greene 2018). Prey densities in the Gulf of St. Lawrence have fluctuated irregularly in the past decade, limiting suitable foraging habitat for North Atlantic right whales in some years and further limiting reproductive rates (Bishop et al. 2022; Gavrilchuck et al. 2020; Gavrilchuck et al. 2021; Lehoux et al. 2020).

Recent studies have investigated the spatial and temporal role of oceanography on copepod availability and distribution and resulting effects on foraging North Atlantic right whales. Changes in seasonal current patterns have an effect on the density of *Calanus* species in the Gulf of St. Lawrence, which may lead to further temporal variations over time (Sorochan et al. 2021a). Brennan et al. (2019) developed a model to estimate seasonal fluctuations in *C. finmarchicus* availability in the Gulf of St. Lawrence, which is highest in summer and fall, aligning with North Atlantic right whale distribution during those seasons. Pendleton et al. (2022) found that the date of maximum occupancy of North Atlantic right whales in Cape Cod

Bay shifted 18.1 days later between 1998 and 2018 and was inversely related to the spring thermal transition date, when the regional ocean temperature surpasses the mean annual temperature for that location, which has trended towards moving earlier each year as an effect of climate change. This inverse relationship may be due to a 'waiting room' effect, where North Atlantic right whales wait and forage on adequate prey in the waters of Cape Cod Bay while richer prey develops in the Gulf of St. Lawrence, and then migrate directly there rather than following migratory pathways used previously (Pendleton et al. 2022; Ganley et al. 2022). Although the date of maximum occupancy in Cape Cod Bay has shifted to later in the spring, initial sightings of individual North Atlantic right whales have started earlier, indicating that they may be using regional water temperature as a cue for migratory movements between habitats (Ganley et al. 2022).

North Atlantic right whales rely on late stage or diapause copepods, which are more energy-rich, for prey; diving behavior is highly reliant on where in the vertical strata *C. finmarchicus* is distributed (Baumgartner et al. 2017). There is evidence that *C. finmarchicus* are reaching the diapause phase at deeper depths to account for warming water on the Newfoundland Slope and Scotian Shelf, forcing North Atlantic right whales to forage deeper and further from shore (Krumhansl et al. 2018; Sorochan et al. 2021a).

Several studies have already used the link between *Calanus* distribution and North Atlantic right whale distribution to determine suitable habitat, both currently and in the future (Gavrilchuk et al. 2020; Pershing et al. 2021; Silber et al. 2017; Sorochan et al. 2021b). Plourde et al. (2019) used suitable habitat modeling using *Calanus* density to confirm new North Atlantic right whale hot spots for summer feeding in Roseway Basin and Grand Manan and identified other potential aggregation areas further out on the Scotian Shelf. Gavrilchuk et al. (2021) determined suitable habitat for reproductive females in the Gulf of St. Lawrence, finding declines in foraging habitat over a 12- year period and indicating that the prey biomass in the area may become insufficient to sustain successful reproduction over time. Ross et al. (2021) used suitable habitat modeling to predict that the Gulf of Maine habitat would continue to decline in suitability until 2050 under a range of climate change scenarios. Similarly, models of future copepod density in the Gulf of Maine have predicted declines of up to 50 percent under high greenhouse gas emission scenarios by 2080- 2100 (Grieve et al. 2017). It is clear that climate change does and will continue to have an impact on the availability, supply, aggregation, and distribution of *C. finmarchicus*, and North Atlantic right whale abundance and distribution will continue to vary based on those impacts; however, more research must be done to better understand these factors and associated impacts (Sorochan et al. 2021b). Climate change will likely have other secondary effects on North Atlantic right whales, such as an increase in harmful algal blooms of the toxic dinoflagellate *Alexandrium catenella* due to warming waters, increasing the risk of North Atlantic right whale exposure to neurotoxins (Boivin-Rioux et al. 2021; Pershing et al. 2021).

Factors outside the Action Area Affecting the Status of the Right Whale: Fishery Interactions and Vessel Strikes in Canadian Waters

In Canada, right whales are protected under the Species at Risk Act (SARA) and the Fisheries Act. The right whale was considered a single species and designated as endangered in 1980. SARA includes provisions against the killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals or its parts (SARA Section 32) and damage or destruction of its residence (SARA Section 33). In 2003, the species was split to allow separate designation of the North Atlantic right whale, which was listed as endangered under SARA in May 2003. All marine mammals are subject to the provisions of the marine mammal regulations under the Fisheries Act. These include requirements related to approach, disturbance, and reporting. In the St. Lawrence estuary and the Saguenay River, the maximum approach distance for threatened or endangered whales is 1,312 ft. (400 m).

North Atlantic right whales have died or been seriously injured in Canadian waters by vessel strikes and entanglement in fishing gear (DFO 2014). Serious injury and mortality events are rarely observed where the initial entanglement occurs. After an event, live whales or carcasses may travel hundreds of miles before ever being observed, including into U.S. waters given prevailing currents. It is unknown exactly how many serious injuries and mortalities have occurred in Canadian waters historically. However, at least 14 right whale carcasses and 20 injured right whales were sighted in Canadian waters between 1988 and 2014 (Davies and Brillant 2019); 25 right whale carcasses were first sighted in Canadian waters or attributed to Canadian fishing gear from 2015 through 2019. In the sections to follow, information is provided on the fishing and shipping industry in Canadian waters, as well as measures the Canadian government is taking (or will be taking) to reduce the level of serious injuries and mortalities to North Atlantic rights resulting from incidental entanglement in fishing gear or vessel strikes.

Fishery Interactions in Canadian Waters

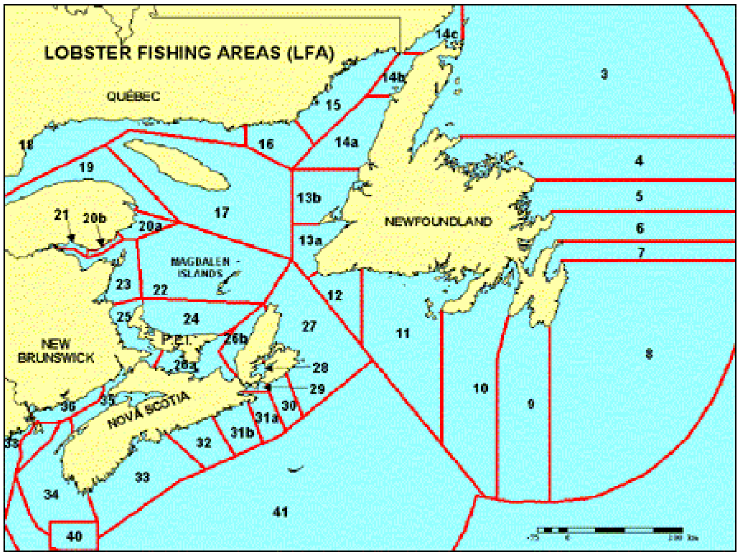
There are numerous fisheries operating in Canadian waters. Rock and toad crab fisheries, as well as fixed gear fisheries for cod, Atlantic halibut, Greenland halibut, winter flounder, and herring have historically had few interactions. While these fisheries deploy gear that pose some risk, this analysis focuses on fisheries that have demonstrated interactions with ESA listed species (i.e., lobster, snow crab, mackerel, and whelk). Based on information provided by the Department of Fisheries and Oceans Canada (DFO), a brief summary of these fisheries is provided below.

The American lobster fishery is DFO's largest fishery, by landings. It is managed under regional management plans with 41 Lobster Fisheries Areas (Figure 5.1.2); in which 10,000 licensed harvesters across Atlantic Canada and Quebec participate.[17] In addition to the one permanent closure in Lobster Fishery Area 40 (Figure 5.1.2), fisheries are generally closed during the summer to protect molts. Lobster fishing is most active in the Gulf of Maine, Bay of Fundy, Southern Gulf of St. Lawrence, and coastal Nova Scotia. Most fisheries take place in shallow waters less than 130 ft. (40 m) deep and within 8 nmi (15 km) of shore, although some fisheries will fish much farther out and in waters up to 660 ft. (200 m) deep. Management measures are tailored to each Area and include limits on the number of licenses issued, limits on the number of traps, limited and staggered fishing seasons, limits on minimum and maximum carapace size (which differs depending on the Area), protection of egg-bearing females (females must be notched and released alive), and ongoing monitoring and enforcement of fishing regulations and license conditions. The Canadian lobster fisheries use trap/pot gear consistent with the gear used in the American lobster fishery in the U.S. While both Canada and the U.S. lobster fisheries

[17] Of the 41 Lobster Fisheries Areas, one is for the offshore fishery, and one is closed for conservation.

employ similar gears, the two nations employ different management strategies that result in divergent prosecution of the fisheries.

Figure 5.1.2. Lobster fishing areas in Atlantic Canada (https://www.dfo-mpo.gc.ca/fisheries-peches/commercial-commerciale/atl-arc/lobster-homard-eng.html)



The snow crab fishery is DFO's second largest fishery, by landings. It is managed under regional management plans with approximately 60 Snow Crab Management Areas in Canada spanning four regions (Scotia-Fundy, Southern Gulf of St. Lawrence, Northern Gulf of St. Lawrence, and Newfoundland and Labrador). Approximately 4,000 crab fishery licenses are issued annually[18]. The management of the snow crab fishery is based on annual total allowable catch, individual quotas, trap and mesh restrictions, minimum legal size, mandatory release of female crabs, minimum mesh size of traps, limited seasons, and areas. Protocols are in place to close grids when a percentage of soft-shell crabs in catches is reached. Harvesters use baited conical traps and pots set on muddy or sand-mud bottoms usually at depths of 230-460 ft. (70-140 m). Annual permit conditions have been used since 2017 to minimize the impacts to North Atlantic right whales, as described below.

DFO manages the Atlantic mackerel fishery under one Atlantic management plan, established in 2007. Management measures include fishing seasons, total allowable catch, gear, Safety at Sea fishing areas, licensing, minimum size, fishing gear restrictions, and monitoring. The plan allows the use of the following gear: gillnet, handline, trap net, seine, and weir. When established, the DFO issued 17,182 licenses across four regions, with over 50% of these licenses using gillnet gear. In 2020, DFO issued 7,812 licenses; no gear information was available. Commercial harvest is timed with the migration of mackerel into and out of Canadian waters. In Nova Scotia, gillnet and trap fisheries for mackerel take place primarily in June and July. Mackerel generally arrive in southwestern Nova Scotia in May and Cape Breton in June. Migration out of the Gulf of St. Lawrence begins in September, and the fishery can continue into

[18] https://www.dfo-mpo.gc.ca/stats/commercial/licences-permis/licences-permis-atl-eng.htm#Species; Last accessed February 12, 2023

October or early November. They may enter the Gulf of St. Lawrence, depending on temperature conditions. The gillnet fishery in the Gulf of St. Lawrence also occurs in June and July. Most nets are fixed, except for a drift fishery in Chaleurs Bay and the part of the Gulf between New Brunswick, Prince Edward Island, and the Magdalen Islands.

Conservation harvesting plans are used to manage waved whelk in Canadian waters, which are harvested in the Gulf of St. Lawrence, Quebec, Maritimes, and Newfoundland and Labrador regions. The fishery is managed using quotas, fishing gear requirements, dockside monitoring, traps limits, seasons, tagging, and area requirements. In 2017, there were 240 whelk license holders in Quebec; however, only 81 of them were active. Whelk traps are typically weighted at the bottom with cement or other means and a rope or other mechanism is positioned in the center of the trap to secure the bait. Between 50 and 175 traps are authorized per license. The total number of authorized traps for all licenses in each fishing area varies between 550 and 6,400 traps, while the number of used or active traps is lower, with 200 to 1,700 traps per fishing area. Since 2017, the Government of Canada has implemented measures to protect right whales from entanglement. These measures have included seasonal and dynamic closures for fixed gear fisheries, changes to the fishing season for snow crab, reductions in traps in the mid-shore fishery in Crab Fishing Area 12, and license conditions to reduce the amount of rope in the water. Measures to better track gear, require reporting of gear loss, require reporting of interactions with marine mammals, and increased surveillance for right whales have also been implemented. Measures to reduce interactions with fishing gear are adjusted annually. In 2021, mandatory closures for non-tended fixed gear fisheries, including lobster and crab, will be put in place for 15 days when right whales are sighted. If a whale is detected in days 9-15 of the closure, the closure will be extended. In the Bay of Fundy and the critical habitats in the Roseway and Grand Manan basins, this extension will be for an additional 15 days. If a right whale is detected in the Gulf of St. Lawrence, the closure will be season-long (until November 15, 2021). Outside the dynamic area, closures are considered on a case-by-case basis. There are also gear marking and reporting requirements for all fixed gear fisheries. The Government of Canada will also continue to support industry trials of innovative fishing technologies and methods to prevent and mitigate whale entanglement. This includes authorizing ropeless gear trials in closed areas in 2021. Measures to implement weak rope or weak-breaking points were delayed and will be implemented by 2024. Measures related to maximum rope diameters, sinking rope between traps and reductions in vertical and floating rope will be implemented after 2022. More information on these measures is available at https://www.dfo-mpo.gc.ca/fisheries-peches/commercial-commerciale/atl-arc/narw-bnan/management-gestion-eng.html.
In August 2016, NMFS published the MMPA Import Provisions Rule (81 FR 54389, August 15, 2016), which established criteria for evaluating a harvesting nation's regulatory program for reducing marine mammal bycatch and the procedures for obtaining authorization to import fish and fish products into the United States. Specifically, to continue in the international trade of seafood products with the United States, other nations must demonstrate that their marine mammal mitigation measures for commercial fisheries are, at a minimum, equivalent to those in place in the United States. A five-year exemption period (beginning January 1, 2017) was created in this process to allow foreign harvesting nations time to develop, as appropriate, regulatory programs comparable in effectiveness to U.S. programs at reducing marine mammal bycatch. To comply with its requirements, it is essential that these interactions are reported, documented, and quantified. To guarantee that fish products have access to the U.S. markets,

DFO must implement procedures to reliably certify that the level of mortality caused by fisheries does not exceed U.S. standards. DFO must also demonstrate that the regulations in place to reduce accidental death of marine mammals are comparable to those of the United States.

Vessel Strikes in Canadian Waters

Vessel strikes are a threat to right whales throughout their range. In Canadian waters where rights whales are present, vessels include recreational and commercial vessels, small and large vessels, and sail, and power vessels. Vessel categories include oil and gas exploration, fishing and aquaculture, cruise ships, offshore excursions (whale and bird watching), tug/tow, dredge, cargo, and military vessels. At the time of development of the Gulf of St. Lawrence management plan, approximately 6,400 commercial vessels transited the Cabot Strait and the Strait of Belle Isle annually. This represents a subset of the vessels in this area as it only includes commercial vessels (DFO 2013). To address vessel strikes in Canadian waters, the International Maritime Organization (IMO) amended the Traffic Separation Scheme in the Bay of Fundy to reroute vessels around high use areas. In 2007, IMO adopted and Canada implemented a voluntary seasonal Area to Be Avoided (ATBA) in Roseway Basin to further reduce the risk of vessel strike (DFO 2020). In addition, Canada has implemented seasonal speed restrictions and developed a proposed action plan to identify specific measures needed to address threats and achieve recovery (DFO 2020).

The Government of Canada has also implemented measures to mitigate vessel strikes in Canadian waters. Each year since August 2017, the Government has implemented seasonal speed restrictions (maximum 10 knots) for vessels 20 m or longer in the western Gulf of St. Lawrence. In 2019, the area was adjusted and the restriction was expanded to apply to vessels greater than 13 m. Smaller vessels are encouraged to respect the limit. Dynamic area management has also been used in recent years. Currently, there are two shipping lanes, south and north of Anticosti Island, where dynamic speed restrictions (mandatory slowdown to 10 knots) can be activated when right whales are present. In 2020 and 2021, the Government of Canada also implemented a trial voluntary speed restriction zone from Cabot Strait to the eastern edge of the dynamic shipping zone at the beginning and end of the season and a mandatory restricted area in or near Shediac Valley mid-season. More information is available at https://www.tc.gc.ca/en/services/marine/navigation-marine-conditions/protecting-north-atlantic-right-whales-collisions-ships-gulf-st-lawrence.html. Modifications to measures in 2021 include refining the size, location, and duration of the mandatory restricted area in and near Shediac Valley and expanding the speed limit exemption in waters less than 20 fathoms to all commercial fishing vessels. In 2022, a variety of measures were in place to reduce the risk of vessel strike including vessel speed limits and restricted access areas.

Critical Habitat

Critical habitat for North Atlantic right whales has been designated in U.S. waters as described in Section 4.0 of this Opinion.

Recovery Goals

Recovery is the process of restoring endangered and threatened species to the point where they no longer require the safeguards of the Endangered Species Act. A recovery plan serves as a road map for species recovery—the plan outlines the path and tasks required to restore and secure self-sustaining wild populations. It is a non-regulatory document that describes, justifies, and schedules the research and management actions necessary to support recovery of a species. The goal of the 2005 Recovery Plan for the North Atlantic right whale (NMFS, 2005) is to promote the recovery of North Atlantic right whales to a level sufficient to warrant their removal from the List of Endangered and Threatened Wildlife and Plants under the ESA. The intermediate recovery goal is to reclassify the species from endangered to threatened. The recovery strategy identified in the Recovery Plan focuses on reducing or eliminating deaths and injuries from anthropogenic activities, namely shipping and commercial fishing operations; developing demographically-based recovery criteria; the characterization, monitoring, and protection of important habitat; identification and monitoring of the status, trends, distribution and health of the species; conducting studies on the effects of other potential threats and ensuring that they are addressed, and conducting genetic studies to assess population structure and diversity. The plan also recognizes the need to work closely with State, other Federal, international and private entities to ensure that research and recovery efforts are coordinated. The recovery plan includes the following downlisting criteria, the achievement of which would demonstrate significant progress toward full recovery:

> North Atlantic right whales may be considered for reclassifying to threatened when all of the following have been met: 1) The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population; 2) The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2% per year; 3) None of the known threats to North Atlantic right whales (summarized in the five listing factors) are known to limit the population's growth rate; and 4) Given current and projected threats and environmental conditions, the right whale population has no more than a 1% chance of quasi-extinction in 100 years.

Specific criteria for delisting North Atlantic right whales are not included in the recovery plan; as described in the recovery plan, conditions related to delisting are too distant and hypothetical to realistically develop specific criteria. The current abundance of North Atlantic right whales is currently an order of magnitude less than an abundance at which NMFS would even consider delisting the species. The current dynamics indicate that the North Atlantic right whale population is in decline, rather than recovering, and decades of population growth at rates considered typical for large whales would be required before the population could attain an abundance that may suggest that delisting was appropriate to consider. Specific criteria for delisting North Atlantic right whales will be included in a future revision of the recovery plan well before the population is at a level when delisting becomes a reasonable decision (NMFS 2005).

The most recent five-year review for right whales was completed in 2022 (NMFS 2022). The recommendation in that plan was for the status to remain as endangered. As described in the report, the North Atlantic right whale faces continued threat of human-caused mortality due to lethal interactions with commercial fisheries and vessel traffic. As stated in the 5-Year Review, there is also uncertainty regarding the effect of long-term sublethal entanglements, emerging environmental stressors including climate change, and the compounding effects of multiple continuous stressors that may be limiting North Atlantic right whale calving and recovery. In addition, the North Atlantic right whale population has been in a state of decline since 2010. Management measures in the United States have been in place for an extended period of time and continued modifications are underway/anticipated, and measures in Canada since 2017 also suggest continued progress toward implementing conservation regulations. Despite these efforts to reduce the decline and promote recovery, progress toward right whale recovery has continued to regress.

5.1.2 Fin Whale (Balaenoptera physalus)

Globally there is one species of fin whale, *Balaenoptera physalus*. Fin whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010a) (Figure 5.1.3). Within this range, three subspecies of fin whales are recognized: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere (NMFS 2010a). For management purposes in the northern Hemisphere, the United States divides, *B. p. physalus,* into four stocks: Hawaii, California/Oregon/Washington, Alaska (Northeast Pacific), and Western North Atlantic (Hayes et al. 2019, NMFS 2010a).

Figure 5.1.3. Range of the fin whale

Fin whales are distinguishable from other whales by a sleek, streamlined body, with a V-shaped head, a tall hooked dorsal fin, and a distinctive color pattern of a black or dark brownish-gray body and sides with a white ventral surface. The lower jaw is gray or black on the left side and creamy white on the right side. The fin whale was listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2010a), recent stock assessment reports (Carretta et al. 2019a, Hayes et al. 2022, Muto et al. 2019), the five-year status review (NMFS 2019b), as well as the recent International Union for the Conservation of Nature's (IUCN) fin whale assessment (Cooke 2018b) were used to summarize the life history, population dynamics and status of the species as follows.

Life History

Fin whales can live, on average, 80 to 90 years. They have a gestation period of less than one year, and calves nurse for six to seven months. Sexual maturity is reached between 6 and 10 years of age with an average calving interval of two to three years. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas.

Population Dynamics
The pre-exploitation estimate for the fin whale population in the entire North Atlantic was approximately 30,000-50,000 animals (NMFS 2010a), and for the entire North Pacific Ocean, approximately 42,000 to 45,000 animals (Ohsumi and Wada 1974). In the Southern Hemisphere, prior to exploitation, the fin whale population was approximately 40,000 whales (Mizroch et al. 1984b). In the North Atlantic Ocean, fin whales were heavily exploited from 1864 to the 1980s; over this timeframe, approximately 98,000 to 115,000 fin whales were killed (IWC 2017). Between 1910 and 1975, approximately 76,000 fin whales were recorded taken by modern whaling in the North Pacific; this number is likely higher as many whales killed were not identified to species or while killed, were not successfully landed (Allison 2017). Over 725,000 fin whales were killed in the Southern Hemisphere from 1905 to 1976 (Allison 2017).

In the North Atlantic Ocean, the IWC has defined seven management stocks of fin whales: (1) North Norway (2) East Greenland and West Iceland (EGI); (3) West Norway and the Faroes; (4) British Isles, Spain and Portugal; (5) West Greenland and (6) Nova Scotia, (7) Newfoundland and Labrador (Donovan 1991, NMFS 2010a). Based on three decades of survey data in various portions of the North Atlantic, the IWC estimates that there are approximately 79,000 fin whales in this region. Under the present IWC scheme, fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland are believed to constitute a single stock; in U.S. waters, NMFS classifies these fin whales as the Western North Atlantic stock (Donovan 1991, Hayes et al. 2019, NMFS 2010a). NMFS' best estimate of abundance for the Western North Atlantic Stock of fin whales is 6,802 individuals (N_{min}=5,573); this estimate is the sum of the 2016 NOAA shipboard and aerial surveys and the 2016 Canadian Northwest Atlantic International Sightings Survey (Hayes et al. 2022). Currently, there is no population estimate for the entire fin whale population in the North Pacific (Cooke 2018b). However, abundance estimates for three stocks in U.S. Pacific Ocean waters do exist: Northeast Pacific (N= 3,168; N_{min}=2,554), Hawaii (N=154; N_{min}=75), and California/Oregon/Washington (N= 9,029; N_{min}=8,127) (Nadeem et al. 2016). Abundance data for the Southern Hemisphere stock remain highly uncertain; however, available information suggests a substantial increase in the population has occurred (Thomas et al. 2016).

In the North Atlantic, estimates of annual growth rate for the entire fin whale population in this region is not available (Cooke 2018b). However, in U.S. Atlantic waters NMFS has determined that until additional data are available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Western North Atlantic stock (Hayes et al. 2019). In the North Pacific, estimates of annual growth rate for the entire fin whale population in this region is not available (Cooke 2018b). However, in U.S. Pacific waters, NMFS has determined that until additional data are available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Northeast Pacific stock (Muto et al. 2019, NMFS 2016b). Overall population growth rates and total abundance estimates for the Hawaii stock of fin whales are not available at this time (Carretta et al. 2018). Based on line transect studies between 1991-2014, there was estimated a 7.5% increase in mean annual abundance in fin whales occurring in waters off California, Oregon, and Washington; to date, this represents the best available information on the current population trend for the overall California/Oregon/Washington stock of fin whales (Carretta et al. 2019a, Nadeem et al. 2016).[19] For Southern Hemisphere fin whales, as noted above, overall information suggests a substantial increase in the population; however, the rate of increase remains poorly quantified (Cooke 2018b).

Archer et al. (2013) examined the genetic structure and diversity of fin whales globally. Full sequencing of the mitochondrial DNA genome for 154 fin whales sampled in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere, resulted in 136 haplotypes, none of which were shared among ocean basins suggesting differentiation at least at this geographic scale. However, North Atlantic fin whales appear to be more closely related to the Southern Hemisphere population, as compared to fin whales in the North Pacific Ocean, which may indicate a revision of the subspecies delineations is warranted. Generally, haplotype diversity was found to be high both within and across ocean basins (Archer et al. 2013). Such high genetic diversity and lack of differentiation within ocean basins may indicate that despite some populations having small abundance estimates, the species may persist long-term and be somewhat protected from substantial environmental variance and catastrophes. Archer et al. 2019 suggests that within the Northern Hemisphere, populations in the North Pacific and North Atlantic oceans can be considered at least different subspecies, if not different species.

Status
The fin whale is endangered because of past commercial whaling. Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whales may be killed under “aboriginal subsistence whaling” in Greenland, under Japan’s scientific whaling program, and Iceland’s formal objection to the IWC’s ban on commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and sound. The species’ overall large population size may provide some resilience to current threats, but trends are largely unknown. The total annual estimated average human-caused mortality and serious injury for the western North Atlantic fin whale for the period 2015−2019 is 1.85 (1.45 incidental fishery interactions and 0.40 vessel collisions) (Henry et al. 2022). Hayes et al. 2022 notes that these represent a minimum estimate of human-caused mortality, which is, almost certainly biased low.

Critical Habitat
No critical habitat has been designated for the fin whale.

Recovery Goals
The goal of the 2010 Recovery Plan for the fin whale (NMFS 2010a) is to promote the recovery of fin whales to the point at which they can be downlisted from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The intermediate goal is to reclassify the species from endangered to threatened. The recovery plan also includes downlisting and delisting criteria. Key elements for the recovery program for fin whales are:

[19] Since 2005, the fin whale abundance increase has been driven by increases off northern California, Oregon, and Washington; numbers off Central and Southern California have remained stable (Carretta et al. 2020, Nadeem et al. 2016).

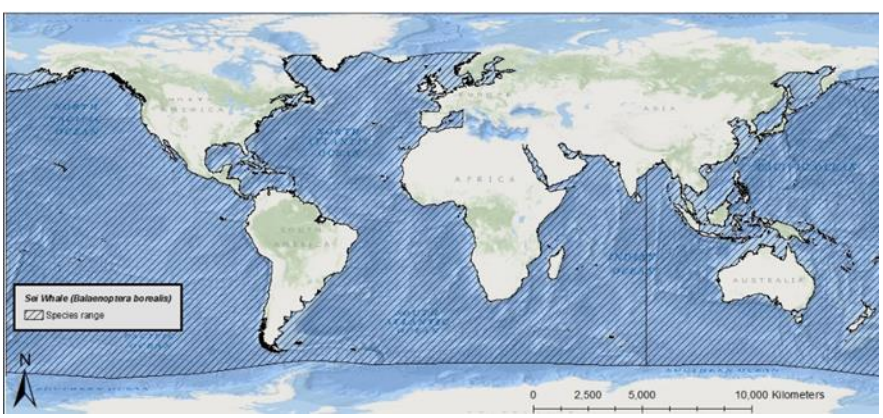
1. Coordinate state, federal, and international actions to implement recovery actions and maintain international regulation of whaling for fin whales;
2. Determine population discreteness and population structure of fin whales;
3. Develop and apply methods to estimate population size and monitor trends in abundance;
4. Conduct risk analysis;
5. Identify, characterize, protect, and monitor habitat important to fin whale populations in U.S. waters and elsewhere;
6. Investigate causes and reduce the frequency and severity of human-caused injury and mortality;
7. Determine and minimize any detrimental effects of anthropogenic noise in the oceans;
8. Maximize efforts to acquire scientific information from dead, stranded, and/or entrapped fin whales; and,
9. Develop post-delisting monitoring plan.

In February 2019, NMFS published a Five-Year Review for fin whales. This 5-year review indicates that, based on a review of the best available scientific and commercial information, that the fin whale should be downlisted from endangered to threatened. The review also recommended that NMFS consider whether listing at the subspecies or distinct population segment level is appropriate in terms of potential conservation benefits and the use of limited agency resources (NMFS 2019). To date, no changes to the listing for fin whales have been proposed.

5.1.3 Sei Whale (Balaenoptera borealis)

Globally there is one species of sei whale, *Balaenoptera borealis borealis*. Sei whales occur in subtropical, temperate, and subpolar marine waters across the Northern and Southern Hemispheres (Figure 5.1.4) (Cooke 2018a, NMFS 2011a). For management purposes, in the Northern Hemisphere, the United States recognizes four sei whale stocks: Hawaii, Eastern North Pacific, and Nova Scotia (NMFS 2011a).

Figure 5.1.4. Range of the sei whale



Sei whales are distinguishable from other whales by a long, sleek body that is dark bluish-gray to black in color and pale underneath, and a single ridge located on their rostrum. The sei whale was listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2011a), recent stock assessment reports (Carretta et al. 2019a, Hayes et al. 2022, Hayes et al. 2017), 5-Year Review (NMFS 2021), as well as the recent IUCN sei whale assessment (Cooke 2018a) were used to summarize the life history, population dynamics and status of the species as follows.

Life History

Sei whales can live, on average, between 50 and 70 years. They have a gestation period of 10 to 12 months, and calves nurse for six to nine months. Sexual maturity is reached between 6 and 12 years of age with an average calving interval of two to three years. Sei whales mostly inhabit continental shelf and slope waters far from the coastline. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed on a range of prey types, including: plankton (copepods and krill), small schooling fishes, and cephalopods.

Population Dynamics

There are no estimates of pre-exploitation sei whale abundance in the entire North Atlantic Ocean; however, approximately 17,000 sei whales were documented caught by modern whaling in the North Atlantic (Allison 2017). In the North Pacific, the pre-whaling sei abundance was estimated to be approximately 42,000 (Tillman 1977 as cited in (NMFS 2011a)). In the Southern Hemisphere, approximately 63,100 to 65,000 occurred in the Southern Hemisphere prior to exploitation (Mizroch et al. 1984a, NMFS 2011a).

In 1989, the entire North Atlantic sei whale population was estimated to be 10,300 whales (Cattanach et al. 1993 as cited in (NMFS 2011a). While other surveys have been completed in portions of the North Atlantic since 1989, the survey coverage levels in these studies are not as complete as those done in Cattanach et al. (1993) (Cooke 2018a). As a result, to date, updated abundance estimates for the entire North Atlantic population of sei whales are not available. However, in the western North Atlantic, Palka et al. (2017) has provided a recent abundance estimate for the Nova Scotia stock of sei whales. Based on survey data collected from Halifax, Nova Scotia, to Florida between 2010 and 2013, it is estimated that there are approximately 6,292 sei whales (N_{min}=3,098) (Palka et al. 2017); this estimate is considered the best available scientific information for the Nova Scotia stock (NMFS 2021). In the North Pacific, an abundance estimate for the entire North Pacific population of sei whales is not available. However, in the western North Pacific, it is estimated that there are 35,000 sei whales (Cooke 2018a). In the eastern North Pacific (considered east of longitude 180^{o}), two stocks of sei whales occur in U.S. waters: Hawaii and Eastern North Pacific. Abundance estimates for the Hawaii stock are 391 sei whales (N_{min}=204), and for Eastern North Pacific stock, 519 sei whales (N_{min}=374) (Carretta et al. 2019a). In the Southern Hemisphere, recent abundance of sei whales is estimated at 9,800 to 12,000 whales. Population growth rates for sei whales are not available at this time as there are little to no systematic survey efforts to study sei whales; however, in U.S. waters, NMFS has determined that until additional data is available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Hawaii, Eastern North Pacific, and Hawaii stocks of sei whales (Hayes 2019).

Based on genetic analyses, there appears to be some differentiation between sei whale populations in different ocean basins. In an early analysis of genetic variation in sei whales, some differences between Southern Ocean and the North Pacific sei whales were detected (Wada and Numachi 1991). However, more recent analyses of mtDNA control region variation show no significant differentiation between Southern Ocean and the North Pacific sei whales, though both appear to be genetically distinct from sei whales in the North Atlantic (Huijser et al. 2018). Within each ocean basin, there appears to be intermediate to high genetic diversity and little genetic differentiation despite there being different managed stocks (Danielsdottir et al. 1991, Kanda et al. 2011, Kanda et al. 2006, Kanda et al. 2013, Kanda et al. 2015).

Status

The sei whale is endangered because of past commercial whaling. Now, only a few individuals are taken each year by Japan. Current threats include vessel strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and anthropogenic sound. Given the species' overall abundance, they may be somewhat resilient to current threats. However, trends are largely unknown, especially for individual stocks, many of which have relatively low abundance estimates. The most recent 5-year average human-caused mortality and serious injury rate for sei whales in the North Atlantic is 0.80 (0.4 incidental fishery interactions, 0.2 vessel collisions, 0.2 other human-caused mortality; Hayes et al. 2022). These represent a minimum estimate of human-caused mortality, which is almost certainly biased low.

Critical Habitat

No critical habitat has been designated for the sei whale.

Recovery Goals

The 2011 Recovery Plan for the sei whale (NMFS 2011b) indicates that, "because the current population status of sei whales is unknown, the primary purpose of this Recovery Plan is to provide a research strategy to obtain data necessary to estimate population abundance, trends, and structure and to identify factors that may be limiting sei whale recovery." The goal of the Recovery Plan is to promote the recovery of sei whales to the point at which they can be downlisted from Endangered to Threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The intermediate goal is to reclassify the species from endangered to threatened. The recovery plan incorporates an adaptive management strategy that divides recovery actions into three tiers. Tier I involves: 1) continued international regulation of whaling (i.e., a moratorium on commercial sei whaling); 2) determining population size, trends, and structure using opportunistic data collection in conjunction with passive acoustic monitoring, if determined to be feasible; and 3) continued stranding response and associated data collection.

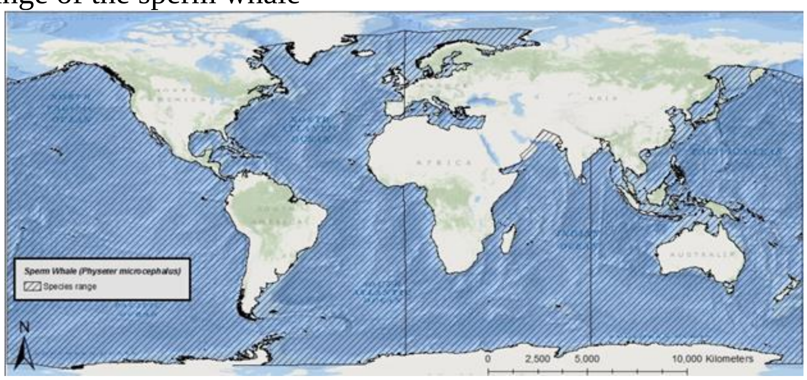
NMFS completed the most recent five-year review for sei whales in 2021 (NMFS 2021). In that review, NMFS concluded that the listing status should remain unchanged. They also concluded that recovery criteria outlined in the sei whale recovery plan (NMFS 2011b) do not reflect the best available and most up-to date information on the biology of the species. The 5-Year review states that currently, there is insufficient data to undertake an assessment of the sei whale's present status due to a number of uncertainties and unknowns for this species: (1) lack of scientifically reliable population estimates for the North Atlantic and Southern Hemisphere; (2) lack of comprehensive information on status and trends; (3) existence of critical knowledge gaps;

and (4) emergence of potential new threats. Thus, further research is needed to fill critical knowledge gaps.

5.1.4 Sperm Whale (Physter macrocephalus)

Globally there is one species of sperm whale, *Physeter macrocephalus*. Sperm whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010b)(Figure 5.1.5). For management purposes, in the Northern Hemisphere, the United States recognizes six sperm whale stocks: California/Oregon/Washington, Hawaii, North Pacific, North Atlantic, Northern Gulf of Mexico, and Puerto Rico and the U.S. Virgin Islands (NMFS 2010b); see NMFS Marine Mammal Stock Assessment Reports: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock).

Figure 5.1.5. Range of the sperm whale



The sperm whale is the largest toothed whale and distinguishable from other whales by its extremely large head, which takes up 25 to 35% of its total body length and a single blowhole asymmetrically situated on the left side of the head near the tip. The sperm whale was originally listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2010b), recent stock assessment reports (Carretta et al. 2018, Hayes et al. 2020, Muto et al. 2019), status review (NMFS 2015b), as well as the recent IUCN sperm whale assessment (Taylor et al. 2019) were used to summarize the life history, population dynamics and status of the species as follows.

Life History

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years, though they may begin to forage for themselves within the first year of life (Tønnesen et al. 2018). Sexual maturity is reached between 7 and 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their 20s. Sperm whales mostly inhabit areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey includes octopus and demersal fish (including teleosts and elasmobranchs).

Population Dynamics

Pre-whaling, the global population of sperm whales was estimated to be approximately 1,100,000 animals (Taylor et al. 2019, Whitehead 2002). By 1880, due to whaling, the population was approximately 71% of its original level (Whitehead 2002). In 1999, ten years after the end of large-scale whaling, the population was estimated to be about 32% of its original level (Whitehead 2002).

The most recent global sperm whale population estimate is 360,000 whales (Whitehead 2009). There are no reliable estimates for sperm whale abundance across the entire (North and South) Atlantic Ocean. However, estimates are available for two of three U.S. stocks in the western North Atlantic Ocean; the Northern Gulf of Mexico stock is estimated to consist of 763 individuals (N_{min}=560) (Waring et al. 2016) and the North Atlantic stock is estimated to consist of 4,349 individuals (N_{min}=3,451) (Hayes 2019). There are insufficient data to estimate abundance for the Puerto Rico and U.S. Virgin Islands stock. Similar to the Atlantic Ocean, there are no reliable estimates for sperm whale abundance across the entire (North and South) Pacific Ocean. However, estimates are available for two of three U.S. stocks that occur in the eastern Pacific; the California/Oregon/ Washington stock is estimated to consist of 1,997 individuals (N_{min}=1,270; Carretta et al. 2019b), and the Hawaii stock is estimated to consist of 4,559 individuals (N_{min}=3,478) (Carretta et al. 2019a). We are aware of no reliable abundance estimates for sperm whales in other major oceans in the Northern and Southern Hemispheres. Although maximum net productivity rates for sperm whales have not been clearly defined, population growth rates for sperm whale populations are expected to be low (i.e., no more than 1.1% per year) (Whitehead 2002). In U.S. waters, NMFS determined that, until additional data is available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for, among others, the North Atlantic, Northern Gulf of Mexico, and Puerto Rico and the U.S. Virgin Islands stocks of sperm whales (Carretta et al. 2019a, Carretta et al. 2019b, Hayes 2019, Muto et al. 2019, Waring et al. 2010, Waring et al. 2016).

Ocean-wide genetic studies indicate sperm whales have low genetic diversity, suggesting a recent bottleneck, but strong differentiation between matrilineally related groups (Lyrholm and Gyllensten 1998). Consistent with this, two studies of sperm whales in the Pacific Ocean indicate low genetic diversity (Mesnick et al. 2011, Rendell et al. 2012). Furthermore, sperm whales from the Gulf of Mexico, the western North Atlantic Ocean, the North Sea, and the Mediterranean Sea all have been shown to have low levels of genetic diversity (Engelhaupt et al. 2009). As none of the stocks for which data are available have high levels of genetic diversity, the species may be at some risk to inbreeding and 'allee' effects[20], although the extent to which is currently unknown. Sperm whales have a global distribution and can be found in relatively deep waters in all ocean basins. While both males and females can be found in latitudes less than 40 degrees, only adult males venture into the higher latitudes near the poles.

Status

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of depletion and degree of recovery of populations are uncertain. Commercial whaling is no longer allowed, however, illegal hunting may occur. Continued threats to sperm whale populations

[20] Allee effects are broadly characterized as a decline in individual fitness in populations with a small size or density.

include vessel strikes, entanglement in fishing gear, competition for resources due to overfishing, loss of prey and habitat due to climate change, and sound. The Deepwater Horizon Natural Resource Damage Assessment Trustees assessed effects of oil exposure on sea turtles and marine mammals. Sperm whales in the Gulf of Mexico were impacted by the oil spill with 3% of the stock estimated to have died (DWH NRDA Trustees 2016). The most recent SAR for sperm whales in the North Atlantic notes that there were no documented reports of fishery-related mortality or serious injury to the North Atlantic stock in the U.S. EEZ during 2013–2017 (Hayes et al. 2020); there are also no reports in NMFS records from 2018-2023. The species' large population size shows that it is somewhat resilient to current threats.

Critical Habitat
No critical habitat has been designated for the sperm whale.

Recovery Goals
The goal of the Recovery Plan is to promote recovery of sperm whales to a point at which they can be downlisted from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The primary purpose of the Recovery Plan is to identify and take actions that will minimize or eliminate effects of human activities that are detrimental to the recovery of sperm whale populations. Immediate objectives are to identify factors that may be limiting abundance, recovery, and/or productivity, and cite actions necessary to allow the populations to increase. The Recovery Plan includes downlisting and delisting criteria (NMFS 2010b).

The most recent Five-Year Review for sperm whales was completed in 2015 (NMFS 2015). In that review, NMFS concluded that no change to the listing status was recommended.

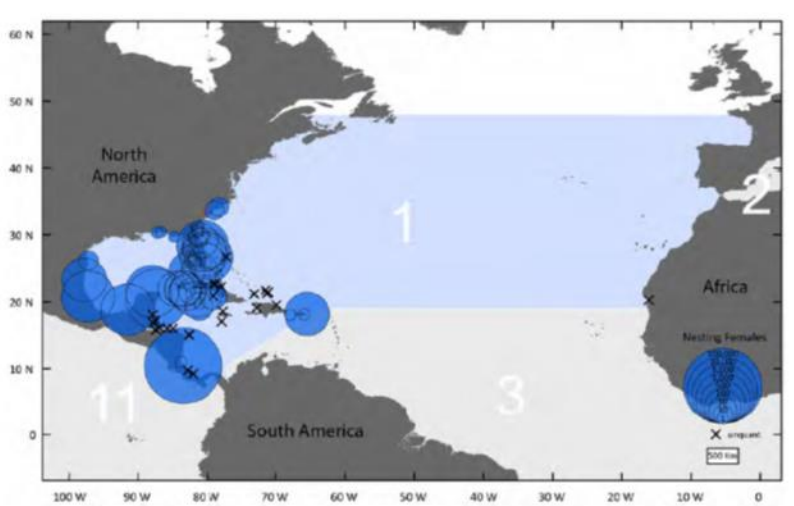
5.2 Sea Turtles

Kemp's ridley and leatherback sea turtles are currently listed under the ESA at the species level; green and loggerhead sea turtles are listed at the DPS level. Therefore, we include information on the range-wide status of Kemp's ridley and leatherback sea turtles to provide the overall status of each species. Information on the status of loggerhead and green sea turtles is for the DPS affected by this action.

5.2.1 Green Sea Turtle (Chelonia mydas, North Atlantic DPS)

The green sea turtle has a circumglobal distribution, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters. They commonly inhabit nearshore and inshore waters. It is the largest of the hardshell marine turtles, growing to a weight of approximately 350 lbs. (159 kg) and a straight carapace length of greater than 3.3 ft. (1 m). The species was listed under the ESA on July 28, 1978 (43 FR 32800) as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 5.2.1) and is listed as threatened. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5° N, 77° W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48° N, 77° W) in the north. The range of the DPS then extends due east along latitudes 48° N and 19° N to the western coasts of Europe and Africa.

Figure 5.2.1. Range of the North Atlantic distinct population segment green turtle (1), with location and abundance of nesting females (Seminoff et al. 2015).



We used information available in the 2015 Status Review (Seminoff et al. 2015), relevant literature, and recent nesting data from the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), United States (Florida) and Cuba support nesting concentrations of particular interest in the North Atlantic DPS (Seminoff et al. 2015). The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff et al. 2015). In the southeastern United States, females generally nest between May and September (Seminoff et al. 2015, Witherington et al. 2006). Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest (Hirth 1997, Seminoff et al. 2015). The remigration interval (period between nesting seasons) is two to five years (Hirth 1997, Seminoff et al. 2015). Nesting occurs primarily on beaches with intact dune structure, native vegetation, and appropriate incubation temperatures during the summer months.

Sea turtles are long-lived animals. Size and age at sexual maturity have been estimated using several methods, including mark-recapture, skeletochronology, and marked known-aged individuals. Skeletochronology analyzes growth marks in bones to obtain growth rates and age at sexual maturity estimates. Estimates vary widely among studies and populations, and methods continue to be developed and refined (Avens and Snover 2013). Early mark-recapture studies in Florida estimated the age at sexual maturity 18-30 years (Frazer and Ehrhart 1985, Goshe et al. 2010, Mendonça 1981). More recent estimates of age at sexual maturity are as high as 35–50 years (Avens and Snover 2013, Goshe et al. 2010), with lower ranges reported from known age

(15–19 years) turtles from the Cayman Islands (Bell et al. 2005) and Caribbean Mexico (12–20 years) (Zurita et al. 2012). A study of green turtles that use waters of the southeastern United States as developmental habitat found the age at sexual maturity likely ranges from 30 to 44 years (Goshe et al. 2010). Green turtles in the Northwestern Atlantic mature at 2.8-33+ ft. (85–100+ cm) straight carapace lengths (SCL) (Avens and Snover 2013).

Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat other invertebrate prey (Seminoff et al. 2015).

Population Dynamics
The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico, and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

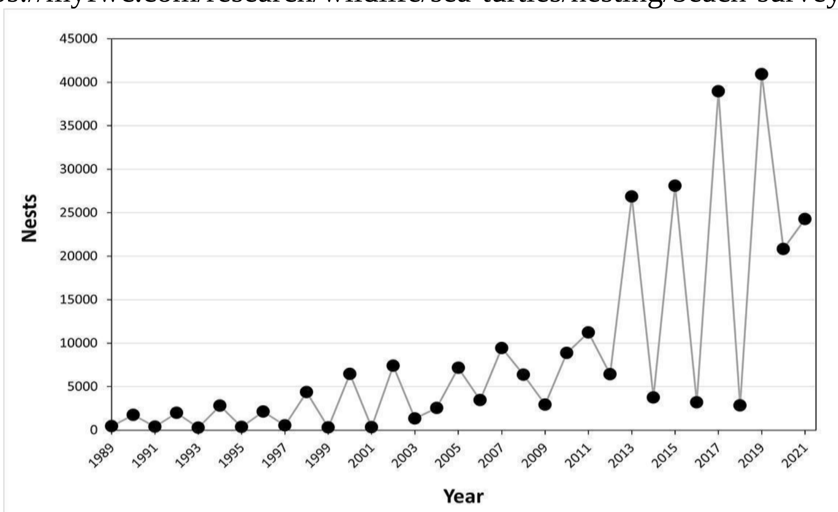
Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three nesting sites (using data through 2012), and available data indicated an increasing trend in nesting (Seminoff et al. 2015). Counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. The status review for green sea turtles assessed population trends for seven nesting sites with more than10 years of data collection in the North Atlantic DPS. The results were variable with some sites showing no trend and others increasing. However, all major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff et al. 2015)).

Recent data is available for the southeastern United States. The FWRI monitors sea turtle nesting through the Statewide Nesting Beach Survey (SNBS) and Index Nesting Beach Survey (INBS). Since 1979, the SNBS has surveyed approximately 215 beaches to collect information on the distribution, seasonality, and abundance of sea turtle nesting in Florida. Since 1989, the INBS has been conducted on a subset of SNBS beaches to monitor trends through consistent effort and specialized training of surveyors. The INBS data uses a standardized data-collection protocol to allow for comparisons between years and is presented for green, loggerhead, and leatherback sea turtles. The index counts represent 27 core index beaches and do not represent Florida's total annual nest counts because they are collected only on a subset of Florida's beaches (27 out of 224 beaches) and only during a 109-day time window (15 May through 31 August). The index nest counts represent approximately 67% of known green turtle nesting in Florida (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

Green turtle nest counts have increased eightyfold since standardized nest counts began in 1989. In 2021, green turtle nest counts on the 27-core index beaches reached more than 24,000 nests recorded. Nesting green turtles tend to follow a two-year reproductive cycle and, typically, there are wide year-to-year fluctuations in the number of nests recorded. Green turtles set record highs in 2011, 2013, 2015, 2017, and 2019. The nest count in 2021 did not set another record high but was only marginally higher than 2020, an unusually high "low year." FWRI reports that changes in the typical two-year cycle have been documented in the past as well (e.g., 2010-2011) and are not reason of concern.

Figure 5.2.2. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)



Status

Historically, green sea turtles in the threatened North Atlantic DPS were hunted for food, which was the principal cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, which is between 30 and 40 years (Seminoff et al. 2015). While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Critical Habitat

Critical habitat for the North Atlantic DPS of green sea turtles surrounds Culebra Island, Puerto Rico (66 FR 20058, April 6, 2016), which is outside the action area. On July 19, 2023, NMFS published a proposed rule to designate specific areas in the marine environment as critical habitat for six DPSs of the green sea turtle, including the North Atlantic DPS. A portion of the proposed critical habitat overlaps with the action area; however, we have not identified any effects of the action on the proposed critical habitat.

Recovery Goals

The most recent Recovery Plan for the U.S. population of green sea turtles in the Atlantic was published in 1991. The goal of the 1991 Recovery Plan is to delist the species once the recovery criteria are met (NMFS and U.S.FWS 1991). The recovery plan includes criteria for delisting related to nesting activity, nesting habitat protection, and reduction in mortality.

Priority actions to meet the recovery goals include:

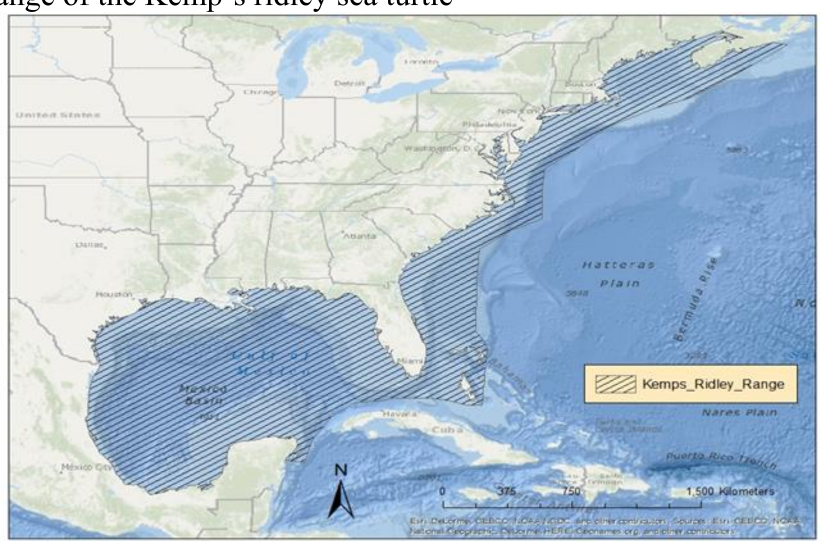
1. Providing long-term protection to important nesting beaches.
2. Ensuring at least a 60% hatch rate success on major nesting beaches.
3. Implementing effective lighting ordinances/plans on nesting beaches.
4. Determining distribution and seasonal movements of all life stages in the marine environment.
5. Minimizing commercial fishing mortality.
6. Reducing threat to the population and foraging habitat from marine pollution.

5.2.2 Kemp's Ridley Sea Turtle (Lepidochelys kempii)

The range of Kemp's ridley sea turtles extends from the Gulf of Mexico to the Atlantic coast (Figure 5.2.3). They have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomás and Raga 2008). They are the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell. The species was first listed under the Endangered Species Conservation Act (35 FR 18319, December 2, 1970) in 1970. The species has been listed as endangered under the ESA since 1973.

We used information available in the revised recovery plan (NMFS et al. 2011), the five-year review (NMFS and USFWS 2015), and published literature to summarize the life history, population dynamics and status of the species, as follows.

Figure 5.2.3. Range of the Kemp's ridley sea turtle



Life History

Kemp's ridley nesting is essentially limited to the western Gulf of Mexico. Approximately 97% of the global population's nesting activity occurs on a 90-mile (146-km) stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the United States, nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and

North Carolina (NMFS and USFWS 2015). Nesting occurs from April to July in large arribadas (synchronized large-scale nesting). The average remigration interval is two years, although intervals of 1 and 3 years are not uncommon (NMFS et al. 2011, TEWG 1998, 2000). Females lay an average of 2.5 clutches per season (NMFS et al. 2011). The annual average clutch size is 95 to 112 eggs per nest (NMFS and USFWS 2015). The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats (Epperly et al. 2013, NMFS and USFWS 2015, Snover et al. 2007). Modeling indicates that oceanic-stage Kemp's ridley turtles are likely distributed throughout the Gulf of Mexico into the northwestern Atlantic (Putman et al. 2013). Kemp's ridley nearing the age when recruitment to nearshore waters occurs are more likely to be distributed in the northern Gulf of Mexico, eastern Gulf of Mexico, and the western Atlantic (Putman et al. 2013).

Several studies, including those of captive turtles, recaptured turtles of known age, mark-recapture data, and skeletochronology, have estimated the average age at sexual maturity for Kemp's ridleys between 5 to 12 years (captive only) (Bjorndal et al. 2014), 10 to 16 years (Chaloupka and Zug 1997, Schmid and Witzell 1997, Schmid and Woodhead 2000, Zug et al. 1997), 9.9 to 16.7 years (Snover et al. 2007), 10 and 18 years (Shaver and Wibbels 2007), 6.8 to 21.8 years (mean 12.9 years) (Avens et al. 2017).

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. The NEFSC caught a juvenile Kemp's ridley during a research project in deep water south of Georges Bank (NEFSC, unpublished data). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter. As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft. (37 m) deep (Seney and Landry 2008, Shaver et al. 2005, Shaver and Rubio 2008), although they can also be found in deeper offshore waters. As larger juveniles and adults, Kemp's ridleys forage on swimming crabs, fish, mollusks, and tunicates (NMFS et al. 2011).

Population Dynamics

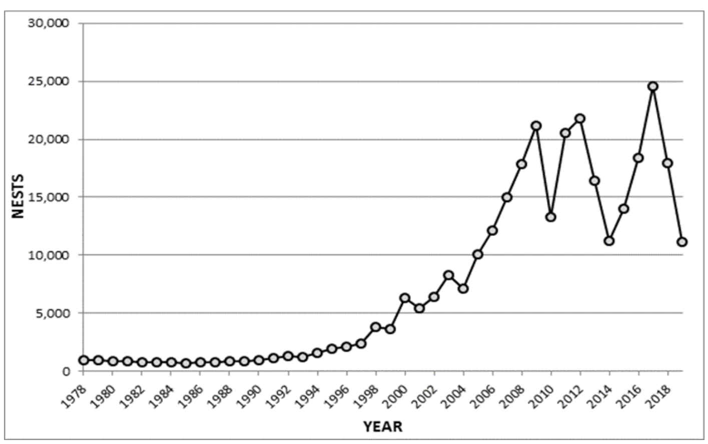
Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased at 15% annually (Heppell et al. 2005). However, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (Caillouet et al. 2018, NMFS and USFWS 2015). In 2019, there were 11,090 nests, a 37.61% decrease from 2018, and a 54.89% decrease from 2017, which had the highest number (24,587) of nests (Figure 5.2.4; unpublished data). The reason for this recent decline is uncertain. In 2021, 198 Kemp's ridley nests were found in Texas – the largest number recorded in Texas since 1978 was in 2017, when 353 nests were documented.

Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of 2 years, and a sex ratio of 3.17 females: 1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true, rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Status

The Kemp's ridley was listed as endangered at the species level in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances in Mexico prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. Nesting beaches in Texas have been re-established. Fishery interactions are the main threat to the species. Other threats include habitat destruction, oil spills, dredging, disease, cold stunning, and climate change. The current population trend is uncertain. While the population has increased, recent nesting numbers have been variable. In addition, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation affecting survival and nesting success is low.

Figure 5.2.4. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019)



Critical Habitat

Critical habitat has not been designated for Kemp's ridley sea turtles.

Recovery Goals

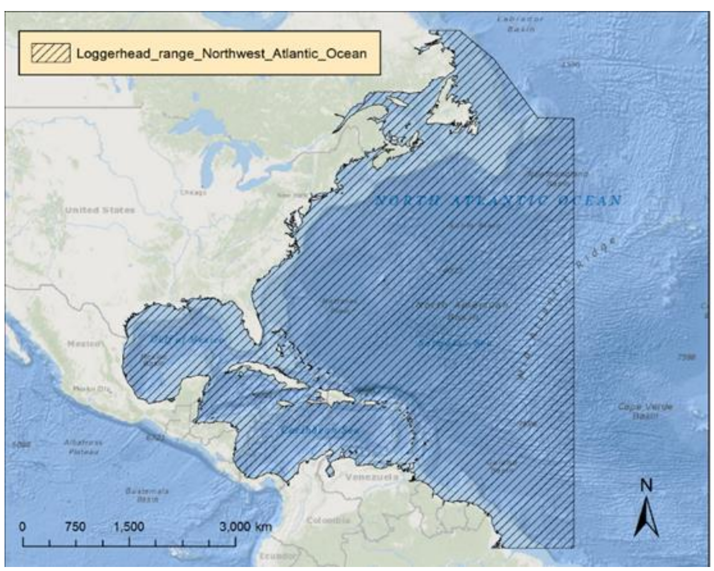
As with other recovery plans, the goal of the 2011 Kemp's ridley recovery plan (NMFS, USFWS, and SEMARNAT 2011) is to conserve and protect the species so that the listing is no longer necessary. The recovery criteria relate to the number of nesting females, hatchling recruitment, habitat protection, social and/or economic initiatives compatible with conservation, reduction of predation, TED or other protective measures in trawl gear, and improved information available to ensure recovery. In 2015, the bi-national recovery team published a number of recommendations including four critical actions (NMFS and USFWS 2015). These include: (a) continue funding by the major funding institutions at a level of support needed to run the successful turtle camps in the State of Tamaulipas, Mexico, in order to continue the high level of hatchling production and nesting female protection; (b) increase turtle excluder device (TED) compliance in U.S. and MX shrimp fisheries; (c) require TEDs in U.S. skimmer trawl fisheries and other trawl fisheries in coastal waters where fishing overlaps with the distribution of Kemp's ridleys; (d) assess bycatch in gillnets in the Northern Gulf of Mexico and State of Tamaulipas, Mexico, to determine whether modifications to gear or fishing practices are needed.

The most recent Five-Year Review was completed in 2015 (NMFS and USFWS 2015) with a recommendation that the status of Kemp's ridley sea turtles should remain as endangered. In the Plan, the Services recommend that efforts continue towards achieving the major recovery actions in the 2015 plan with a priority for actions to address recent declines in the annual number of nests.

5.2.3 Loggerhead Sea Turtle (Caretta caretta, Northwest Atlantic Ocean DPS)

Loggerhead sea turtles are circumglobal and are found in the temperate and tropical regions of the Indian, Pacific, and Atlantic Oceans. The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws. The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and USFWS designated nine distinct population segments of loggerhead sea turtles, with the Northwest Atlantic Ocean DPS listed as threatened (76 FR 58868). The Northwest Atlantic Ocean DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 5.2.5).

Figure 5.2.5. Range of the Northwest Atlantic Ocean DPS of loggerhead sea turtles



We used information available in the 2009 Status Review (Conant et al. 2009), the final listing rule (76 FR 58868, September 22, 2011), the relevant literature, and recent nesting data from the FWRI to summarize the life history, population dynamics and status of the species, as follows.

Life History

Nesting occurs on beaches where warm, humid sand temperatures incubate the eggs. Northwest Atlantic females lay an average of five clutches per year. The annual average clutch size is 115 eggs per nest. Females do not nest every year. The average remigration interval is three years. There is a 54% emergence success rate (Conant et al. 2009). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in coastal waters. Some juveniles may periodically move between the oceanic zone and coastal waters (Bolten 2003, Conant et al. 2009, Mansfield 2006, Morreale and Standora 2005, Witzell 2002). Coastal waters provide important foraging, inter-nesting, and migratory habitats for adult loggerheads. In both the oceanic zone and coastal waters, loggerheads are primarily carnivorous, although they do consume some plant matter as well (Conant et al. 2009). Loggerheads have been documented to feed on crustaceans, mollusks, jellyfish and salps, and algae (Bjorndal 1997, Donaton et al. 2019, Seney and Musick 2007). Avens et al. (2015) used three approaches to estimate age at maturation. Mean age predictions associated with minimum and mean maturation straight carapace lengths were 22.5-25 and 36-38 years for females and 26-28 and 37-42 years for males. Male and female sea turtles have similar post-maturation longevity, ranging from 4 to 46 (mean 19) years (Avens et al. 2015).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. MtDNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71%-88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010). LaCasalla et al. (2013) found that loggerheads, primarily juveniles, caught within the Northeast Distant (NED) waters of the North Atlantic mostly originated from nesting populations in the southeast United States and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2%), primarily from the large eastern Florida rookeries. There was little evidence of contributions from the South Atlantic, Northeast Atlantic, or Mediterranean DPSs (LaCasella et al. 2013). A more recent analysis assessed sea turtles captured in fisheries in the Northwest Atlantic and included samples from 850 (including 24 turtles caught during fisheries research) turtles caught from 2000-2013 in coastal and oceanic habitats (Stewart et al. 2019). The turtles were primarily captured in pelagic longline and bottom otter trawls. Other gears included bottom longline, hook and line, gillnet, dredge, and dip net. Turtles were identified from 19 distinct management units; the western Atlantic nesting populations were the main contributors with little representation from the Northeast Atlantic, Mediterranean, or South Atlantic DPSs (Stewart et al. 2019). There was a significant split in the distribution of small (≤ 2 ft. (63 cm) SCL) and large (> 2 ft. (63 cm) SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44%±15%) and the northern United States management units (33%±16%); small turtles came from central east Florida (64%±14%). South of Cape Hatteras, large turtles came mainly from central east Florida (52%±20%) and southeast Florida (41%±20%); small turtles came from southeast Florida (56%±25%). The authors concluded that bycatch in the western North Atlantic would affect the Northwest Atlantic DPS almost exclusively (Stewart et al. 2019).

Population Dynamics
A number of stock assessments and similar reviews (Conant et al. 2009, Heppell et al. 2005, NMFS SEFSC 2001, 2009, Richards et al. 2011, TEWG 1998, 2000, 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none has been able to develop a reliable estimate of absolute population size. As with other species, counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

Based on genetic analysis of nesting subpopulations, the Northwest Atlantic Ocean DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant et al. 2009). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct (Shamblin et al. 2014). The recent genetic analyses suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).
The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). Using data from 2004-2008, the adult female population size of the DPS was estimated at 20,000 to 40,000 females (NMFS SEFSC 2009). More recently, Ceriani and Meylan (2017) reported a 5-year average (2009-2013) of more than 83,717 nests per year in the southeast United States and Mexico (excluding Cancun (Quintana Roo, Mexico). These estimates included sites without long-term (≥10 years) datasets. When they used data from 86 index sites (representing 63.4% of the estimated nests for the whole DPS with long-term datasets, they reported 53,043 nests per year. Trends at the different index nesting beaches ranged from negative to positive. In a trend analysis of the 86 index sites, the overall trend for the Northwest Atlantic DPS was positive (+2%) (Ceriani and Meylan 2017). Uncertainties in this analysis include, among others, using nesting females as proxies for overall population abundance and trends, demographic parameters, monitoring methodologies, and evaluation methods involving simple comparisons of early and later 5-year average annual nest counts. However, the authors concluded that the subpopulation is well monitored and the data evaluated represents 63.4 % of the total estimated annual nests of the subpopulation and, therefore, are representative of the overall trend (Ceriani and Meylan 2017).

About 80% of loggerhead nesting in the southeast United States occurs in six Florida counties (NMFS and USFWS 2008). The Peninsula Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the Northwest Atlantic DPS (Ceriani and Meylan 2017, NMFS and USFWS 2008). As described above, FWRI's INBS collects standardized nesting data. The index nest counts for loggerheads represent approximately 53% of known nesting in Florida. There have been three distinct intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-

2021). At core index beaches in Florida, nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In 2019, more than 53,000 nests were documented. In 2020, loggerhead turtles had another successful nesting season with more than 49,100 nests documented. The nest counts in Figure 5.2.6 represent peninsular Florida and do not include an additional set of beaches in the Florida Panhandle and southwest coast that were added to the program in 1997. Nest counts at these Florida Panhandle index beaches have an upward trend since 2010 (Figure 5.2.7).

Figure 5.2.6. Annual nest counts of loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)

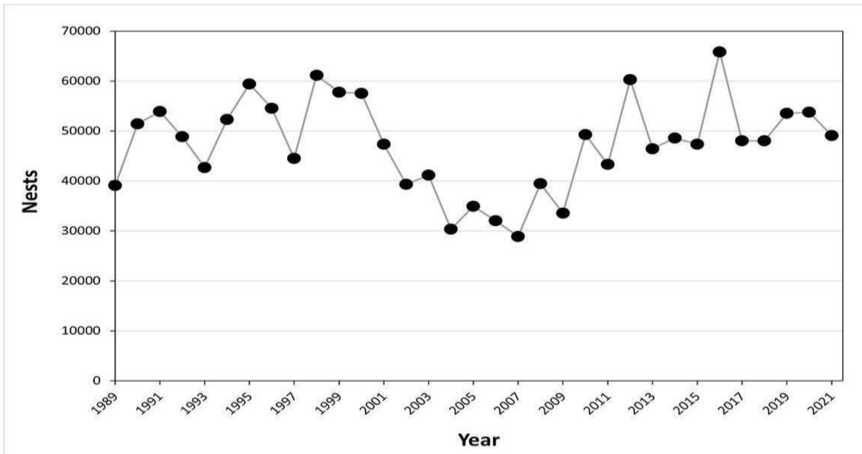
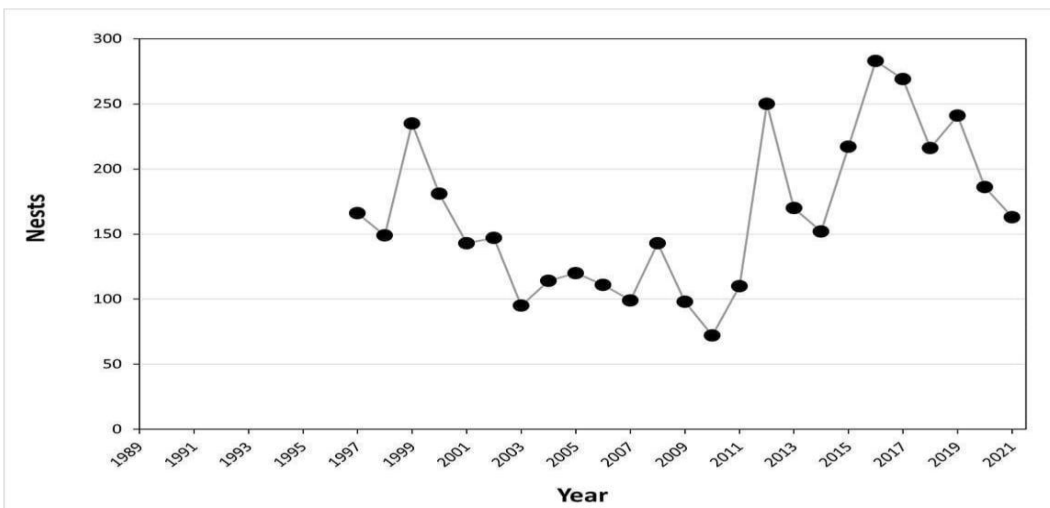


Figure 5.2.7. Annual nest counts of loggerhead sea turtles on index beaches in the Florida Panhandle, 1997-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)



The annual nest counts on Florida's index beaches fluctuate widely, and we do not fully understand what drives these fluctuations. In assessing the population, Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Trends by recovery unit were variable.

The Peninsular Florida Recovery Unit extends from the Georgia-Florida border south and then north (excluding the islands west of Key West, Florida) through Pinellas County on the west coast of Florida. Annual nest counts from 1989 to 2018 ranged from a low of 28,876 in 2007 to a high of 65,807 in 1998 (Bolten et al. 2019). More recently (2008-2018), counts have ranged from 33,532 in 2009 to 65,807 in 2016 (Bolten et al. 2019). Nest counts taken at index beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Trend analyses have been completed for various periods. From 2009 through 2013, a 2% decrease for this recovery unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests (Bolten et al. 2019). It is important to recognize that an increase in the number of nests has been observed since 2007. The recovery team cautions that using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten et al. 2019).

The Northern Recovery Unit, ranging from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS. Annual nest totals for this recovery unit from 1983 to 2019 have ranged from a low of 520 in 2004 to a high of 5,555 in 2019 (Bolten et al. 2019). From 2008 to 2019, counts have ranged from 1,289 nests in 2014 to 5,555 nests in 2019 (Bolten et al. 2019). Nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and USFWS 2008). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% (Bolten et al. 2019). The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS and USFWS 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas recovery unit (Ceriani et al. 2019, Ceriani and Meylan 2017), which accounts for less than 1% of the Northwest Atlantic DPS (Ceriani and Meylan 2017).

The Northern Gulf of Mexico Recovery Unit is defined as loggerheads originating from beaches in Franklin County on the northwest Gulf coast of Florida through Texas. From 1995 to 2007, there were an average of 906 nests per year on approximately 300 km of beach in Alabama and Florida, which equates to about 221 females nesting per year (NMFS and USFWS 2008). Annual nest totals for this recovery unit from 1997-2018 have ranged from a low of 72 in 2010 to a high of 283 in 2016 (Bolten et al. 2019). Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult because of changed and expanded beach coverage. However, there are now over 20 years of Florida index nesting beach survey data. A number of trend analyses have been conducted. From 1995 to 2005, the recovery unit exhibited a significant declining trend (Conant et al. 2009, NMFS, and USFWS 2008). Nest numbers have increased in recent years (Bolten et al. 2019) (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten et al. 2019).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013.

Status

Fisheries bycatch is the highest threat to the threatened Northwest Atlantic DPS of loggerhead sea turtles (Conant et al. 2009). Other threats include boat strikes, marine debris, coastal development, habitat loss, contaminants, disease, and climate change. Nesting trends for each of the loggerhead sea turtle recovery units in the Northwest Atlantic Ocean DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Critical Habitat

Critical habitat for the Northwest Atlantic DPS was designated in 2014 (see Section 4).

Recovery Goals

The recovery goal for the Northwest Atlantic loggerhead is to ensure that each recovery unit meets its recovery criteria, alleviating threats to the species so that protection under the ESA is not needed. The recovery criteria relate to the number of nests and nesting females, trends in abundance on the foraging grounds, and trends in neritic strandings relative to in-water abundance. The 2008 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads includes the complete downlisting/delisting criteria (NMFS and U.S. FWS 2008). The recovery objectives to meet these goals include:

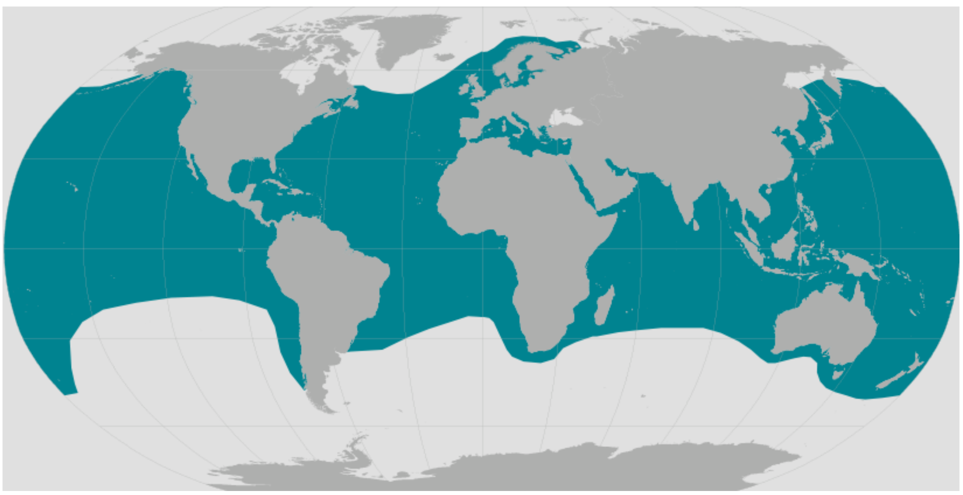
1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.

8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

5.2.4 Leatherback Sea Turtle (Dermochelys coriacea)

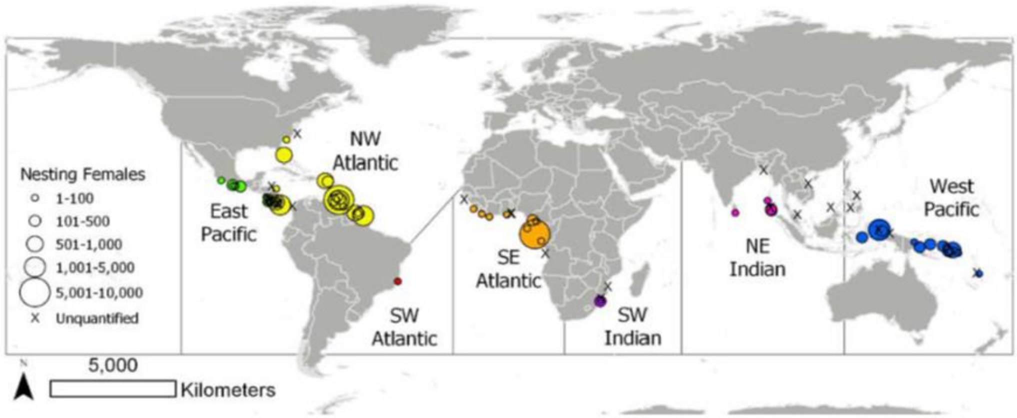
The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 5.2.8).

Figure 5.2.8. Range of the leatherback sea turtle



Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their plastron. The species was first listed under the Endangered Species Conservation Act (35 FR 8491, June 2, 1970) and has been listed as endangered under the ESA since 1973. In 2020, seven leatherback populations that met the discreteness and significance criteria of the distinct population segment policy were identified (NMFS and USFWS 2020). The population found within the action area is the Northwest Atlantic population segment (NW Atlantic) (Figure 5.2.9). NMFS and USFWS concluded that the seven populations, which met the criteria for DPSs, all met the definition of an endangered species. However, NMFS and USFWS determined that the listing of DPSs was not warranted; leatherbacks continue to be listed as a species at the global level (85 FR 48332, August 10, 2020). Therefore, information is presented on the range-wide status of the species. We used information available in the five-year review (NMFS and USFWS 2013), the critical habitat designation (44 FR 17710, March 23, 1979), the most recent status review (NMFS and USFWS 2020), relevant literature, and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

Figure 5.2.9. Leatherback sea turtle DPSs and nesting beaches (NMFS and USFWS 2020)



Life History

Leatherbacks are a long-lived species. Preferred nesting grounds are in the tropics; though, nests span latitudes from 34 °S in Western Cape, South Africa to 38 °N in Maryland (Eckert et al. 2012, Eckert et al. 2015). Females lay an average of five to seven clutches (range: 1-14 clutches) per season, with 20 to over 100 eggs per clutch (Eckert et al. 2012, Reina et al. 2002, Wallace et al. 2007). The average clutch frequency for the NW Atlantic population segment is 5.5 clutches per season (NMFS and USFWS 2020). In the western Atlantic, leatherbacks lay about 82 eggs per clutch (Sotherland et al. 2015). Remigration intervals are 2-4 years for most populations (range 1-11 years) (Eckert et al. 2015, NMFS and USFWS 2020); the remigration interval for the NW Atlantic population segment is approximately 3 years (NMFS and USFWS 2020). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergence success) is approximately 50% worldwide (Eckert et al. 2012).

Age at sexual maturity has been challenging to obtain given the species physiology and habitat use (Avens et al. 2019). Past estimates ranged from 5-29 years (Avens et al. 2009, Spotila et al. 1996). More recently, Avens et al. (2020) used refined skeletochronology to assess the age at sexual maturity for leatherback sea turtles in the Atlantic and the Pacific. In the Atlantic, the mean age at sexual maturity was 19 years (range 13-28) and the mean size at sexual maturity was 4.2 ft. (129.2 cm) CCL (range (3.7-5 ft. (112.8-153.8 cm)). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 4.2 ft. (129.3 cm) CCL (range 3.6- 5 ft. (110.7-152.3 cm)) (Avens et al. 2019).

Leatherbacks have a greater tolerance for colder waters compared to all other sea turtle species due to their thermoregulatory capabilities (Paladino et al. 1990, Shoop and Kenney 1992, Wallace and Jones 2008). Evidence from tag returns, satellite telemetry, and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between temperate/boreal and tropical waters (Bond and James 2017, Dodge et al. 2015, Eckert et al. 2006, Fossette et al. 2014, James et al. 2005a, James et al. 2005b, James et al. 2005c, NMFS and USFWS 1992). Tagging studies collectively show a clear separation of leatherback movements between the North and South Atlantic Oceans (NMFS and USFWS 2020).

Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005c, Wallace et al. 2006). Studies on the foraging ecology of leatherbacks in the North Atlantic show that leatherbacks off Massachusetts primarily consumed lion's mane, sea nettles, and ctenophores (Dodge et al. 2011). Juvenile and small sub-adult leatherbacks may spend more time in oligotrophic (relatively low plant nutrient usually accompanied by high dissolved oxygen) open ocean waters where prey is more difficult to find (Dodge et al. 2011). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals are dependent upon foraging success and duration (Hays 2000, Price et al. 2004).

Population Dynamics
The distribution is global, with nesting beaches in the Pacific, Atlantic, and Indian Oceans. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (NMFS and USFWS 2020, Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

Analyses of mtDNA from leatherback sea turtles indicates a low level of genetic diversity (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian Oceans suggest that each of the rookeries represent demographically independent populations (NMFS and USFWS 2013). Using genetic data,, combined with nesting, tagging, and tracking data, researchers identified seven global regional management units (RMU) or subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace et al. 2010). The status review concluded that the RMUs identified by Wallace et al. (2010) are discrete populations and, then, evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS and USFWS 2020).

To evaluate the RMUs and fine-scale structure in the Atlantic, Dutton et al. (2013) conducted a comprehensive genetic re-analysis of rookery stock structure. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton et al. 2013). While Dutton et al. (2013) identified fine-scale genetic partitioning in the Atlantic Ocean, the differences did not rise to the level of marked separation or discreteness (NMFS and USFWS 2020). Other genetic analyses corroborate the conclusions of Dutton et al. (2013). These studies analyzed nesting sites in French Guiana (Molfetti et al. 2013), nesting and foraging areas in Brazil (Vargas et al. 2019), and nesting beaches in the Caribbean (Carreras et al. 2013). These studies all support three discrete populations in the Atlantic (NMFS and USFWS 2020). While these studies detected fine-scale genetic differentiation in the NW, SW, and SE Atlantic populations, the status review team determined that none indicated that the genetic differences were sufficient to be considered marked separation (NMFS and USFWS 2020).

Population growth rates for leatherback sea turtles vary by ocean basin. An assessment of leatherback populations through 2010 found a global decline overall (Wallace et al. 2013). Using datasets with abundance data series that are 10 years or greater, they estimated that leatherback populations have declined from 90,599 nests per year to 54,262 nests per year over three generations ending in 2010 (Wallace et al. 2013).

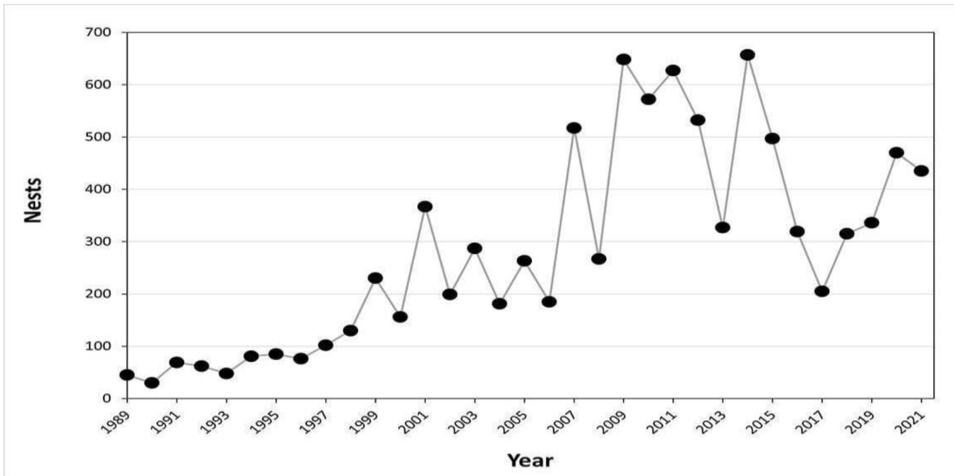
Several more recent assessments have been conducted. The Northwest Atlantic Leatherback Working Group was formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the NW Atlantic Ocean subpopulation estimated 20,000 mature individuals and approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019). Annual nest counts show high inter-annual variability within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). Using data from 24 nesting sites in 10 nations within the NW Atlantic population segment, the leatherback status review estimated that the total index of nesting female abundance for the NW Atlantic population segment is 20,659 females (NMFS and USFWS 2020). This estimate only includes nesting data from recently and consistently monitored nesting beaches. An index (rather than a census) was developed given that the estimate is based on the number of nests on main nesting beaches with recent and consistent data and assumes a 3-year remigration interval. This index provides a minimum estimate of nesting female abundance (NMFS and USFWS 2020). This index of nesting female abundance is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). As described above, the IUCN Red List Assessment estimated 20,000 mature individuals (male and female). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and USFWS 2020).

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari et al. 2013b). However, based on more recent analyses, leatherback nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease occurring during the most recent period of 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). The analyses for the IUCN Red List assessment indicate that the overall regional, abundance-weighted trends are negative (Northwest Atlantic Leatherback Working Group 2018, 2019). The dataset for trend analyses included 23 sites across 14 countries/territories. Three periods were used for the trend analysis: long-term (1990-2017), intermediate (1998-2017), and recent (2008-2017) trends. Overall, regional, abundance-weighted trends were negative across the periods and became more negative as the time-series became shorter. At the stock level, the Working Group evaluated the NW Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The NW Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana, Suriname, Cayenne, and Matura. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017. The Northern Caribbean and Western Caribbean stocks also declined over all three periods. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent time period. The Working Group identified anthropogenic sources (fishery bycatch, vessel strikes), habitat loss, and changes in life history parameters as possible drivers of nesting abundance declines (Northwest Atlantic Leatherback Working Group 2018). Fisheries bycatch is a well-documented threat to leatherback turtles. The Working Group discussed entanglement in vertical line fisheries off New England and Canada as potentially important mortality sinks. They also noted that vessel strikes result in mortality annually in feeding habitats off New England. Off nesting beaches in Trinidad and the Guianas, net fisheries take leatherbacks in high numbers (~3,000/yr.) (Eckert 2013, Lum 2006, Northwest Atlantic Leatherback Working Group 2018).

Similarly, the leatherback status review concluded that the NW Atlantic population segment exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Significant declines have been observed at nesting beaches with the greatest historical or current nesting female abundance, most notably in Trinidad and Tobago, Suriname, and French Guiana. Though some nesting aggregations (see status review document for information on specific nesting aggregations) indicated increasing trends, most of the largest ones are declining. The declining trend is considered to be representative of the population segment (NMFS and USFWS 2020). The status review found that fisheries bycatch is the primary threat to the NW Atlantic population (NMFS and USFWS 2020).

Leatherback sea turtles nest in the southeastern United States. From 1989-2019, leatherback nests at core index beaches in Florida have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Leatherback nest numbers reached a peak in 2014 followed by a steep decline (2015-2017) and a promising increase (2018-2021) (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/) (Figure 5.2.10). The status review found that the median trend for Florida from 2008-2017 was a decrease of 2.1% annually (NMFS and USFWS 2020). Surveyors counted 435 leatherback nests on the 27 core index beaches in 2021. These counts do not include leatherback nesting at the beginning of the season (before May 15), nor do they represent all the beaches in Florida where leatherbacks nest; however, the index provided by these counts remains a representative reflection of trends. However, while green turtle nest numbers on Florida's index beaches continue to rise, Florida hosts only a few hundred nests annually and leatherbacks can lay as many as 11 clutches during a nesting season. Thus, fluctuations in nest count may be the result of a small change in number of females. More years of standardized nest counts are needed to understand whether the fluctuation is natural or warrants concern.

Figure 5.2.10. Number of leatherback sea turtle nests on core index beaches in Florida from 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/)



For the SW Atlantic population segment, the status review estimates the total index of nesting female abundance at approximately 27 females (NMFS and USFWS 2020). This is similar to the IUCN Red List assessment that estimated 35 mature individuals (male and female) using nesting data since 2010. Nesting has increased since 2010 overall, though the 2014-2017 estimates were lower than the previous three years. The trend is increasing, though variable (NMFS and USFWS 2020). The SE Atlantic population segment has an index of nesting female abundance of 9,198 females and demonstrates a declining nest trend at the largest nesting aggregation (NMFS and USFWS 2020). The SE population segment exhibits a declining nest trend (NMFS and USFWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris et al. 2017, Santidrián Tomillo et al. 2017, Santidrián Tomillo et al. 2007, Sarti Martínez et al. 2007, Tapilatu et al. 2013). For an IUCN Red List evaluation, datasets for nesting at all index beaches for the West Pacific population were compiled (Tiwari et al. 2013a). This assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013a). Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation declined at a rate of almost 6% per year from 1984 to 2011 (Tapilatu et al. 2013). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific population segment at 1,277 females, and the population exhibits low hatchling success (NMFS and USFWS 2020). The total index of nesting female abundance for the East Pacific population segment is 755 nesting females. It has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). The low productivity parameters, drastic reductions in nesting female abundance, and current declines in nesting place the population segment at risk (NMFS and USFWS 2020).

Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately 10 females nest per year from 1994 to 2004, and about 296 nests per year were counted in South Africa (NMFS and USFWS 2013). A 5-year status review in 2013 found that, in the southwest Indian Ocean, populations in South Africa are stable (NMFS and USFWS 2013). More recently, the 2020 status review estimated that the total index of nesting female abundance for the SW Indian population segment is 149 females and that the population is exhibiting a slight decreasing nest trend (NMFS and USFWS 2020). While data on nesting in the NE Indian Ocean populations segment is limited, the population is estimated at 109 females. This population has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and USFWS 2020).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. There has been a global decline overall. For all population segments, including the NW Atlantic population, fisheries bycatch is the primary threat to the species (NMFS and USFWS 2020). Leatherback turtle nesting in the Northwest Atlantic showed an overall negative trend through 2017, with the most notable decrease occurring during the most recent time frame of 2008 to 2017 (Northwest Atlantic Leatherback Working Group 2018). Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. Therefore, the leatherback status review in 2020 concluded that the NW Atlantic population exhibits an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020). Threats to leatherback sea turtles include loss of nesting habitat, fisheries bycatch, vessel strikes, harvest of eggs, and marine debris, among others (Northwest Atlantic Leatherback Working Group 2018). Because of the threats, once large nesting areas in the Indian and Pacific Oceans are now functionally extinct (Tiwari et al. 2013a) and there have been range-wide reductions in population abundance. The species' resilience to additional perturbation both within the NW Atlantic and worldwide is low.

Critical Habitat

Critical habitat has been designated for leatherback sea turtles in the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710, March 23, 1979) and along the U.S. West Coast (77 FR 4170, January 26, 2012), both of which are outside the action area.

Recovery Goals

There are separate recovery plans for the U.S. Caribbean, Gulf of Mexico, and Atlantic (NMFS and USFWS 1992) and the U.S. Pacific (NMFS and USFWS 1998) populations of leatherback sea turtles. Neither plan has been recently updated. As with other sea turtle species, the recovery plans for leatherbacks include criteria for considering delisting. These criteria relate to increases in the populations, nesting trends, nesting beach and habitat protection, and implementation of priority actions. Criteria for delisting in the recovery plan for the U.S. Caribbean, Gulf of Mexico, and Atlantic are described here.

Delisting criteria

1. Adult female population increases for 25 years after publication of the recovery plan, as evidenced by a statistically significant trend in nest numbers at Culebra, Puerto Rico; St. Croix, U.S. Virgin Islands; and the east coast of Florida.

2. Nesting habitat encompassing at least 75% of nesting activity in the U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership.
3. All priority-one tasks have been successfully implemented (see the recovery plan for a list of priority one tasks).

Major recovery actions in the U.S. Caribbean, Gulf of Mexico, and Atlantic include actions to:

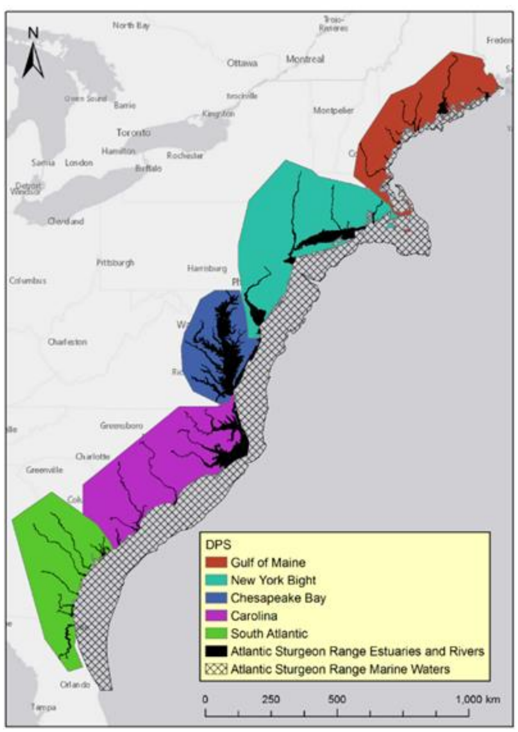
1. Protect and manage terrestrial and marine habitats.
2. Protect and manage the population.
3. Inform and educate the public.
4. Develop and implement international agreements.

The 2013 Five-Year Review (NMFS and USFWS 2013) concluded that the leatherback turtle should not be delisted or reclassified and notes that the 1991 and 1998 recovery plans are dated and do not address the major, emerging threat of climate change.

5.3 Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus)

An estuarine-dependent anadromous species, Atlantic sturgeon occupy ocean and estuarine waters, including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASSRT 2007) (Figure 5.3.1). On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered.

Figure 5.3.1. U.S. range of Atlantic sturgeon DPSs



Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2017 ASMFC benchmark stock assessment (ASMFC 2017), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), material supporting the designation of Atlantic sturgeon critical habitat (NMFS 2017a), and Five-Year Reviews completed for the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs (NMFS 2022a, b, c) were used to summarize the life history, population dynamics, and status of the species.

Life History
Atlantic sturgeon are a late maturing, anadromous species (ASSRT 2007, Balazik et al. 2010, Hilton et al. 2016, Sulak and Randall 2002). Sexual maturity is reached between the ages of 5 to 34 years. Sturgeon originating from rivers in lower latitudes (e.g., South Carolina rivers) mature faster than those originating from rivers located in higher latitudes (e.g., Saint Lawrence River) (NMFS 2017a).

Atlantic sturgeon spawn in freshwater (ASSRT 2007, NMFS 2017b) at sites with flowing water and hard bottom substrate (Bain et al. 2000, Balazik et al. 2012b, Gilbert 1989, Greene et al. 2009, Hatin et al. 2002, Mohler 2003, Smith and Clugston 1997, Vladykov and Greeley 1963). Water depths of spawning sites are highly variable, but may be up to 88.5 ft. (27 m) (Bain et al. 2000, Crance 1987, Leland 1968, Scott and Crossman 1973). Based on tagging records, Atlantic sturgeon return to their natal rivers to spawn (ASSRT 2007), with spawning intervals ranging from one to five years in males (Caron et al. 2002, Collins et al. 2000b, Smith 1985) and two to five years in females (Stevenson and Secor 1999, Van Eenennaam et al. 1996, Vladykov and Greeley 1963). Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Balazik and Musick 2015, Collins et al. 2000b), although the majority likely have just one, either in the spring or fall.[21] There is evidence of spring and fall spawning for the South Atlantic DPS (77 FR 5914, February 6, 2012, Collins et al. 2000b, NMFS and USFWS 1998b) (Collins et al. 2000b, NMFS and USFWS 1998), spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017a), and fall spawning for the Chesapeake and Carolina DPSs (Balazik et al. 2012a, Smith et al. 1984). While spawning has not been confirmed in the James River (Chesapeake Bay DPS), telemetry and empirical data suggest that there may be two potential spawning runs: a spring run from late March to early May and a fall run around September after an extended staging period in the lower river (Balazik et al. 2012a, Balazik and Musick 2015).

Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Bain 1997, Bain et al. 2000, Balazik et al. 2012a, Breece et al. 2013, Dovel and Berggren 1983a, Greene et al. 2009, Hatin et al. 2002, Ingram et al. 2019, Smith 1985, Smith et al. 1982). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Bain 1997, Bain et al. 2000, Balazik et al. 2012a, Breece et al. 2013, Dovel and Berggren 1983a, Greene et al. 2009, Hatin et al. 2002, NMFS 2017a, Smith 1985, Smith et al. 1982). Atlantic sturgeon deposit eggs on hard bottom substrate. They hatch into the yolk sac larval stage approximately 94 to 140 hours after

[21] Although referred to as spring spawning and fall spawning, the actual time of Atlantic sturgeon spawning may not occur during the astronomical spring or fall season (Balazik and Musick 2015).

deposition (Mohler 2003, Murawski and Pacheco 1977, Smith et al. 1980, Van Den Avyle 1984, Vladykov and Greeley 1963). Once the yolk sac is absorbed (eight to twelve days post-hatching), sturgeon are larvae. Shortly after, they become young of year and then juveniles. The juvenile stage can last months to years in the brackish waters of the natal estuary (ASSRT 2007, Calvo et al. 2010, Collins et al. 2000a, Dadswell 2006, Dovel and Berggren 1983b, Greene et al. 2009, Hatin et al. 2007, Holland and Yelverton 1973, Kynard and Horgan 2002, Mohler 2003, Schueller and Peterson 2010, Secor et al. 2000, Waldman et al. 1996). Size and age that individuals leave their natal river for the marine environment is variable at the individual and geographic level; age and size of maturity is similarly variable. Upon reaching the sub-adult phase, individuals enter the marine environment, mixing with adults and sub-adults from other river systems (Bain 1997, Dovel and Berggren 1983a, Hatin et al. 2007, McCord et al. 2007) (NMFS 2017a). Once sub-adult Atlantic sturgeon have reached maturity/the adult stage, they will remain in marine or estuarine waters, only returning far upstream to the spawning areas when they are ready to spawn (ASSRT 2007, Bain 1997, Breece et al. 2016, Dunton et al. 2012, Dunton et al. 2015, Savoy and Pacileo 2003).

The life history of Atlantic sturgeon can be divided up into seven general categories as described in Table 5.3.1 below (adapted from ASSRT 2007). Note that the size and duration information presented in the table below should be considered a generalization and there is individual and geographic variation.

Table 5.3.1. General descriptions of Atlantic sturgeon life history stages

Age Class	Typical Size	General Duration	Description
Egg	~2 mm – 3 mm diameter (Van Eenennaam et al. 1996)(p. 773)	Hatching occurs ~3-6 days after egg deposition and fertilization (ASSRT 2007)(p. 4))	Fertilized or unfertilized
Yolk-sac larvae (YSL)	~6mm – 14 mm (Bath et al. 1981)(pp. 714-715))	8-12 days post hatch (ASSRT 2007)(p. 4))	Negative photo-taxic, nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14mm – 37mm (Bath et al. 1981)(pp. 714-715))	12-40 days post hatch	Free swimming; feeding; Silt/sand bottom, deep channel; fresh water
Young of Year (YOY)	0.3 grams <410mm TL	From 40 days to 1 year	Fish that are > 40 days and < one year; capable of capturing and consuming live food
Juveniles	>410mm and <760mm TL	1 year to time at which first coastal migration is made	Fish that are at least age 1 and are not sexually mature and do not make coastal migrations.

Age Class	Typical Size	General Duration	Description
Subadults	>760 mm and <1500 mm TL	From first coastal migration to sexual maturity	Fish that are not sexually mature but make coastal migrations
Adults	>1500 mm TL	Post-maturation	Sexually mature fish

Population Dynamics
A population estimate was derived from the NEAMAP trawl surveys.[22] For this Opinion, we are relying on the population estimates derived from the NEAMAP swept area biomass assuming a 50% catchability (i.e., net efficiency x availability) rate. We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon but do not sample all the locations and times where Atlantic sturgeon are present. We also consider that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assume that net efficiency and the fraction of the population exposed to the NEAMAP surveys in combination result in a 50% catchability (NMFS 2013). The 50% catchability assumption reasonably accounts for the robust, yet not complete, sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear. As these estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we believe these estimates continue to serve as the best available information. Based on the above approach, the overall abundance of Atlantic sturgeon in U.S. Atlantic waters is estimated to be 67,776 fish (see table16 in Kocik et al. 2013). Based on genetic frequencies of occurrence in the sampled area, this overall population estimate was subsequently partitioned by DPS (Table 5.3.2). Given the proportion of adults to sub-adults in the NMFS NEFSC observer data (approximate ratio of 1:3), we have also estimated the number of adults and sub-adults originating from each DPS. However, this cannot be considered an estimate of the total number of sub-adults because it only considers those sub-adults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.

It is important to note, the NEAMAP-based estimates do not include young-of-the-year (YOY) fish and juveniles in the rivers; therefore, the NEAMAP-based estimates underestimate the total population size as they do not account for multiple year classes of Atlantic sturgeon that do not occur in the marine environment where the NEAMAP surveys take place. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of sub-adult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. However, the estimated number of sub-adults in marine waters is a minimum count because it only considers those sub-adults that are captured in a portion of the action area and are present in the marine environment, which is only a fraction of the total number of sub-adults. In regards to adult Atlantic sturgeon, the estimated population in marine waters is also a minimum count as the NEAMAP surveys sample only a portion of the action area, and therefore a portion of the Atlantic sturgeon's range.

[22] Since fall 2007, NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 60 ft. (18.3 m). Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations.

Table 5.3.2. Calculated population estimates based upon the NEAMAP survey swept area model, assuming 50% efficiency

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Sub-adults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada (outside of the 5 ESA listed DPSs)	*678*	*170*	*509*

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The Commission's 2017 stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model for which the available data did not or poorly fit. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC 2017).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT 2007, Bowen and Avise 1990, O'Leary et al. 2014, Ong et al. 1996, Waldman et al. 1996, Waldman and Wirgin 1998). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Fritts et al. 2016, Savoy et al. 2017, Wirgin et al. 2002) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range. Based on a recent genetic mixed stock analysis (Kazyak et al. 2021; the Atlantic Shores WDA falls within the "MID Offshore" area described in that paper.), we expect Atlantic sturgeon in the portions of the action area north of Cape Hatteras to originate from the five DPSs at the following frequencies: New York Bight (55.3%), Chesapeake (22.9%), South Atlantic (13.6%), Carolina (5.8%), and Gulf of Maine (1.6%) DPSs. It is possible that a small fraction (0.7%) of Atlantic sturgeon in the area may be Canadian origin (Kazyak et al. 2021); Canadian-origin Atlantic sturgeon are not listed under the ESA. This represents the best available information on the likely genetic makeup of individuals occurring in the lease area, the cable routes, and vessel transit routes north of Cape Hatteras. The portion of the action area south of Cape Hatteras falls with the "SOUTH" region described in Kazyak et al. 2021; Atlantic sturgeon in this portion of the action area are expected to be nearly all from the South Atlantic DPS (91.2%) and the Carolina DPS (6.2%), with few individuals from the Chesapeake Bay and New York Bight DPSs. The only activities in this portion of the action area are limited vessel trips moving along the U.S. Atlantic south coast between the project areas and Corpus Christi, TX.

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 164 ft. (50 m) depth contour (Dunton et al. 2012, Dunton et al. 2010, Erickson et al. 2011, Laney et al. 2007, O'Leary et al. 2014, Stein et al. 2004a, b, Waldman et al. 2013, Wirgin et al. 2015a, Wirgin et al. 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 250 ft. (75 m)) continental shelf waters have been documented (Colette and Klein-MacPhee 2002, Collins and Smith 1997, Erickson et al. 2011, Stein et al. 2004b, Timoshkin 1968). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton et al. 2010, Erickson et al. 2011, Hilton et al. 2016, Oliver et al. 2013, Post et al. 2014, Wippelhauser 2012). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 66 ft. (20 m), during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 66 ft. (20 m) (Erickson et al. 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina; Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 82 ft. (25 m) (Bain et al. 2000, Dunton et al. 2010, Erickson et al. 2011, Laney et al. 2007, O'Leary et al. 2014, Oliver et al. 2013, Savoy and Pacileo 2003, Stein et al. 2004b, Waldman et al. 2013, Wippelhauser 2012, Wippelhauser and Squiers 2015). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refugia, wintering sites, or marine foraging areas (Dunton et al. 2010, Erickson et al. 2011, Stein et al. 2004b).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT 2007). They are currently present in 36 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or YOY observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid-1990s. Based on management recommendations in the ISFMP, adopted by the Commission in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from most coastal states (ASMFC 1998a). In 1998, the Commission placed a 20-40 year moratorium on all Atlantic sturgeon fisheries until the spawning stocked could be restored to a level where 20 subsequent year classes of adult females were protected (ASMFC 1998a, b). In 1999, NMFS closed the U.S. EEZ to Atlantic sturgeon retention, pursuant to the ACA (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this.

The most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

The Atlantic States Marine Fisheries Commission released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). Based on historic removals and estimated effective population size, the 2017 stock assessment concluded that all five Atlantic sturgeon DPSs are depleted relative to historical levels. However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC 2017). The 2017 stock assessment also concluded that a variety of factors (i.e., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC 2017). While bycatch in federal and state fisheries is a primary source of anthropogenic mortality of Atlantic sturgeon, to date, ESA section 7 consultations conducted by NMFS on federal fisheries (e.g., NMFS 2021 "batched fisheries Opinion") have concluded that these activities will not jeopardize the continued existence of any Atlantic sturgeon DPSs. New data indicates that bycatch in at least some of the federal fisheries considered in the 2021 consultation is, however, higher than what we considered in the 2021 biological opinion, and the batch consultation on the authorization of multiple federal fisheries is currently being reinitiated.

Despite the depleted status, the Commission's assessment did include signs that the coastwide index is above the 1998 value (95% probability). Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. By DPS, the assessment concluded that there was a 51% probability that the Gulf of Maine DPS abundance has increased since 1998 but a 74% probability that mortality for this DPS exceeds the mortality threshold used for the assessment. There is a relatively high (75%) probability that the New York Bight DPS abundance has increased since 1998, and a 31% probability that mortality exceeds the mortality threshold used for the assessment. There is also a relatively high (67%) probability that the Carolina DPS abundance has increased since 1998, and a relatively high probability (75%) that mortality for this DPS exceeds the mortality threshold used in the assessment. However, the index from the Chesapeake Bay DPS (highlighted red) only had a 36% chance of being above the 1998 value and a 30% probability that the mortality for this DPS exceeds the mortality threshold for the assessment. There was not enough information available to assess the abundance for the South Atlantic DPS relative to the 1998 moratorium, but the assessment did conclude that there was 40% probability that the mortality for this DPS exceeds the mortality threshold used in the assessment (ASMFC 2017).

Recovery Goals

A Recovery Plan has not been completed for any DPS of Atlantic sturgeon. In 2018, NMFS published a Recovery Outline[23] to serve as an initial recovery-planning document. In this, the recovery vision is stated, "Subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future." The Outline also includes steps that are expected to serve as an initial recovery action plan. These include protecting extant subpopulations and the species' habitat through reduction of threats; gathering information through research and monitoring on current distribution and abundance; and addressing vessel strikes in rivers, the effects of climate change and bycatch.

5.3.1 Gulf of Maine DPS

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning occurs in the Kennebec River. The capture of a larval Atlantic sturgeon in the Androscoggin River below the Brunswick Dam in the spring of 2011 indicates spawning may also occur in that river. Despite the presence of suitable spawning habitat in a number of other rivers, there is no evidence of recent spawning in the remaining rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS (ASSRT, 2007; Fernandes, *et al.*, 2010).

The current status of the Gulf of Maine DPS is affected by historical and modern fisheries dating as far back as the 1800s (Squiers *et al.*, 1979; Stein *et al.*, 2004; ASMFC 2007). Incidental capture of Atlantic sturgeon in state and Federal fisheries continues today. As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast Fishery Management Plans. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999, the Veazie Dam on the Penobscot River). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted

[23] https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed September 30, 2023.

using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8% (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, 2012).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

In 2018, we announced the initiation of a 5-year review for the Gulf of Maine DPS. We reviewed and considered new information for the Gulf of Maine DPS that has become available since this DPS was listed as threatened in February 2012. We completed the 5-year review for the Gulf of Maine DPS in February 2022 (NMFS 2022a). Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.2 New York Bight DPS

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers. There is no recent evidence (within the last 15 years) of spawning in the Taunton River (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

In 2014, several presumed age-0 Atlantic sturgeon were captured in the Connecticut River; the available information indicates that successful spawning took place in 2013 by a small number of adults. Genetic analysis of the juveniles indicates that the adults were likely migrants from the South Atlantic DPS (Savoy et al. 2017). As noted by the authors, this conclusion is counter to prevailing information regarding straying of adult Atlantic sturgeon. As these captures represent the only contemporary records of possible natal Atlantic sturgeon in the Connecticut River and the genetic analysis is unexpected, more information is needed to establish the frequency of spawning in the Connecticut River and whether there is a unique Connecticut River population of Atlantic sturgeon.

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800s is unknown but has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. A decline in the abundance of young Atlantic sturgeon appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s while the CPUE is generally higher in the 2000s as compared to the 1990s. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. Standardized mean catch per net set from the NYSDEC juvenile Atlantic sturgeon survey have had a general increasing trend from 2006 – 2015, with the exception of a dip in 2013.

In addition to capture in fisheries operating in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery (shad) that impacted juvenile sturgeon in the Hudson River, has now been closed and there is no indication that it will reopen soon. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Impingement at water intakes, including the Danskammer, Roseton, and Indian Point power plants has been documented in the past; all three of these facilities have recently shut down. Recent information from surveys of juveniles (see above) indicates that the number of young Atlantic sturgeon in the Hudson River is increasing compared to recent years, but is still low compared to the 1970s. There is currently not enough information regarding any life stage to establish a trend for the entire Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009-year class YOY indicates that at least three females successfully contributed to the 2009-year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under federal Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat, and altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and a number of Atlantic sturgeon have been killed during Delaware River channel maintenance and deepening activities.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware and Hudson rivers. Delaware State University (DSU) collaborated with the Delaware Division of Fish and Wildlife (DDFW) in an effort to document vessel strikes in 2005. Approximately 200 reported carcasses with over half being attributed to vessel strikes based on a gross examination of wounds have been documented through 2019 (DiJohnson 2019). Information from carcass studies indicates that only a small percentage of carcasses in the Delaware River are documented and reported (Fox et al. 2020). One hundred thirty-eight (138) sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS; we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. We determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

In 2018, we announced the initiation of a 5-year review for the New York Bight DPS. We reviewed and considered new information for the New York Bight DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the DPS in February 2022 (NMFS 2022b). Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.3 Chesapeake Bay DPS

The Chesapeake Bay (CB) DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 5.3.1. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e., dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007).

At the time of listing, the James River was the only known spawning river for the Chesapeake Bay DPS (ASSRT, 2007; Hager, 2011; Balazik et al., 2012). Since the listing, evidence has been provided of both spring and fall spawning populations for the James River, as well as fall spawning in the Pamunkey River, a tributary of the York River, and fall spawning in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al., 2014; Kahn et al., 2014; Balazik and Musick, 2015; Richardson and Secor, 2016). Detections of acoustically-tagged adult Atlantic sturgeon along with historical evidence suggests that Atlantic sturgeon belonging to the Chesapeake Bay DPS may be spawning in the Mattaponi and Rappahannock rivers as well (Hilton et al. 2016; ASMFC 2017a; Kahn et al. 2019). However, information for these populations is limited and the research is ongoing.

Several threats play a role in shaping the current status of CB DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder 1928; Vladykov and Greeley 1963; ASMFC 1998b; Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007; Balazik *et al.* 2010). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced available spawning habitat in the James River (Holton and Walsh 1995; Bushnoe *et al.* 2005; ASSRT 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the CB DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.* 2004; ASMFC 1998a; ASSRT 2007; EPA 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20th century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.

Although there have been improvements in some areas of the Bay's health, the ecosystem remains in poor condition. At this time, we do not have sufficient information to quantify the extent that degraded water quality affects habitat or individuals in the Chesapeake Bay watershed.

More than 100 Atlantic sturgeon carcasses have been salvaged in the James River since 2007 and additional carcasses were reported but could not be salvaged (Greenlee et al. 2019). Many of the salvaged carcasses had evidence of a fatal vessel strike. In addition, vessel struck Atlantic sturgeon have been found in other parts of the Chesapeake Bay DPS's range including in the York and Nanticoke river estuaries, within Chesapeake Bay, and near the mouth of the Bay since the DPS was listed as endangered (NMFS Sturgeon Salvage Permit Reporting; Secor et al. 2021).

In the marine and coastal range of the CB DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.* 2004b; ASMFC TC 2007; ASSRT 2007).

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the CB DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were CB DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007). The CB DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

In 2018, we announced the initiation of a 5-year review for the Chesapeake Bay DPS. We reviewed and considered new information for the Chesapeake Bay DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the Chesapeake Bay DPS in February 2022 (NMFS 2022c). Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.4 Carolina DPS

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida.

Rivers in the Carolina DPS considered to be spawning rivers include the Neuse, Roanoke, Tar-Pamlico, Cape Fear, and Northeast Cape Fear rivers, and the Santee-Cooper and Pee Dee river (Waccamaw and Pee Dee rivers) systems. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. We have no information, current or historical, of Atlantic sturgeon using the Chowan and New Rivers in North Carolina. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same period. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with a potential extirpation in an additional system. The ASSRT estimated the remaining river populations within the DPS to have fewer than 300 spawning adults; this is thought to be a small fraction of historic population sizes (ASSRT 2007).

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen (DO)) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially, by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Carolina DPS Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

In 2018, we announced the initiation of a 5-year review for the Carolina DPS. We reviewed and considered new information for the Carolina DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the Carolina DPS in September 2023 (NMFS 2023a). Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.5 South Atlantic DPS

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, St. Marys, and Satilla Rivers. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Post et al. (2014) also found Atlantic sturgeon only use the portion of the Waccamaw River downstream of Bull Creek. Due to manmade structures and alterations, spawning areas in the St. Johns River are not accessible and therefore do not support a reproducing population.

Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The ASSRT estimated the abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, to be less than 1 percent of what they were historically (ASSRT 2007).

The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day (mgd) of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exist on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

In 2018, we announced the initiation of a 5-year review for the South Atlantic DPS. We reviewed and considered new information for the South Atlantic DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the South Atlantic DPS in September 2023 (NMFS 2023b). Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.6 Critical Habitat Designated for the New York Bight DPS of Atlantic Sturgeon

Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. Critical habitat designated in the Delaware River for the New York Bight DPS of Atlantic sturgeon is the only critical habitat that may be affected by the proposed action. The area within the Delaware River designated as critical habitat for Atlantic sturgeon extends from the Delaware River at the crossing of the Trenton-Morrisville Route 1 Toll Bridge, downstream for 137 RKMs to where the main stem river discharges at its mouth into Delaware Bay. As identified in the final rule, the physical features that are essential to the conservation of the species and that may require special management considerations or protection are:

1) Hard bottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
3) Water of appropriate depth and absent physical barriers to passage (*e.g.,* locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:
    i) Unimpeded movement of adults to and from spawning sites;
    ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
    iii) Staging, resting, or holding of subadults or spawning condition adults.

Water depths in main river channels must also be deep enough (*e.g.*, at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.

4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:
   i) Spawning;
   ii) Annual and interannual adult, subadult, larval, and juvenile survival; and
   iii) Larval, juvenile, and subadult growth, development, and recruitment (*e.g.*,13°C to 26°C for spawning habitat and no more than 30°C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

The action area considered in this biological opinion includes the Delaware River critical habitat unit from the mouth of the river to Paulsboro, New Jersey (approximately RKM 145). The critical habitat designation is bank-to-bank within the Delaware River. Each critical habitat unit contains all four of the physical features (referred to as physical or biological features (PBF)); however, only PBFs 2, 3, and 4 occur in the action area. In the Delaware River, the area upstream of RKM 122 is considered to have the salinity levels consistent with the requirements of PBF 1. Information on the PBFs within the action area is contained in the *Environmental Baseline* section.

5.4 Shortnose Sturgeon (*Acipenser brevirostrum*)

The only activity considered in this Opinion that may adversely affect shortnose sturgeon is vessel traffic in the Delaware River. Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT, 2010). They have a head covered in bony plates, as well as protective armor called scutes extending from the base of the skull to the caudal peduncle. Other distinctive features include a subterminal, protractile tube-like mouth and chemosensory barbels for benthic foraging (SSSRT, 2010). Sturgeon have been present in North America since the Upper Cretaceous period, more than 66 million years ago. The information below is a summary of available information on the species. More thorough discussions can be found in the cited references as well as the Shortnose Sturgeon Status Review Team's (SSSRT) Biological Assessment (2010).

Life History and General Habitat Use

There are differences in life history, behavior, and habitat use across the range of the species. Current research indicates that these differences are adaptations to unique features of the rivers where these populations occur. For example, there are differences in larval dispersal patterns in the Connecticut River (MA) and Savannah River (GA) (Parker, 2007). There are also morphological and behavioral differences. Growth and maturation occurs more quickly in southern rivers but fish in northern rivers grow larger and live longer. We provide general life history attributes in Table 5.4.1.

Table 5.4.1. Shortnose sturgeon general life history for the species throughout its range

Stage	Typical Size (mm)	General Duration	Behaviors/Habitat Used
Egg	3-4	13 days postspawn	stationary on bottom; Cobble and rock, fresh, fast flowing water (0.4-0.8 m/s)
Yolk Sac Larvae	7-15	8-12 days post hatch	Photonegative; swim up and drift behavior; form aggregations with other YSL; Cobble and rock, stay at bottom near spawning site
Post Yolk Sac Larvae	15 - 57	12-40 days post hatch	Free swimming; feeding; Silt bottom, deep channel; fresh water
Young of Year	57 – 140 (north); 57-300 (south)	From 40 days post-hatch to one year	Deep, muddy areas upstream of the salt wedge
Juvenile	140 to 450-550 (north); 300 to 450-550 (south)	1 year to maturation	Increasing salinity tolerance with age; same habitat patterns as adults
Adult	450-1100 average; (max recorded 1400)	Post-maturation	Freshwater to estuary with some individuals making nearshore coastal migrations

Shortnose sturgeon live on average for 30-40 years (Dadswell et al., 1984). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Dadswell et al., 1984). Females typically spawn for the first time 5 years post-maturation (age 12-18; Dadswell, 1979; Dadswell et al., 1984) and then spawn every 3-5 years (Dadswell, 1979; Dadswell et al., 1984;). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Kieffer and Kynard, 1996; NMFS, 1998; Dadswell et al., 1984). Shortnose sturgeon are iteroparous (spawning more than once during their life) and females release eggs in multiple “batches” during a 24 to 36-hour period (total of 30,000-200,000 eggs). Multiple males are likely to fertilize the eggs of a single female.

Cues for spawning are thought to include water temperature, day length and river flow (Kynard et al, 2012, Kynard et al. 2016). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Dadswell, 1979; Taubert, 1980a and b; Kynard, 1997). Spawning occurs over gravel, rubble, and/or cobble substrate (Dadswell, 1979, Taubert, 1980a and b; Buckley and Kynard, 1985b; Kynard, 1997) in areas with average bottom velocities between 0.4 and 0.8 m/s. Depths at spawning sites are variable, ranging from 1.2 - 27 m (multiple references in SSSRT (2010)). Eggs are small and demersal and stick to the rocky substrate where spawning occurs.

Shortnose sturgeon occur in waters between 0-34°C (Dadswell et al., 1984; Heidt & Gilbert, 1978); with temperatures above 28°C considered to be stressful. Depths used are highly variable, ranging from shallow mudflats while foraging to deep channels up to 30 m (Dadswell et al., 1984; Dadswell, 1979). Salinity tolerance increases with age; while young of the year must remain in freshwater, adults have been documented in the ocean with salinities of up 30 parts-per-thousand (ppt) (Holland and Yeverton, 1973; Saunders and Smith, 1978). Dissolved oxygen affects distribution, with preference for DO levels at or above 5mg/l and adverse effects anticipated for prolonged exposure to DO less than 3.2mg/L (Secor and Niklitschek 2001).

Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al., 1984). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson, 1987; Kynard, 1997). Shortnose sturgeon have also been observed feeding off plant surfaces (Dadswell et al., 1984).

Following spawning, adult shortnose sturgeon disperse quickly down river to summer foraging grounds areas and remain in areas downstream of their spawning grounds throughout the remainder of the year (Buckley and Kynard, 1985a, Dadswell et al., 1984; Buckley and Kynard, 1985b; O'Herron et al., 1993).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Kynard et al., 2012; Buckley and Kynard, 1985a; Dadswell, 1979, Li et al., 2007; Dovel et al., 1992; Bain et al., 1998a and b). In the winter, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith, 1993, Weber et al., 1998). Prespawning sturgeon in some northern and southern systems migrate into an area in the upper tidal portion of the river in the fall and complete their migration in the spring (Rogers and Weber, 1995). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins et al., 1993; Jarvis et al. 2001).

Listing History
Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Shortnose sturgeon are thought to have been abundant in nearly every large East Coast river prior to the 1880s (see McDonald, 1887; Smith and Clugston, 1997). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. The species remains listed as endangered throughout its range. While the 1998 Recovery Plan refers to Distinct Population Segments (DPS), the process to designate DPSs for this species has not been undertaken. The SSSRT published a Biological Assessment for shortnose sturgeon in 2010. The report summarized the status of shortnose sturgeon within each river and identified stressors that continue to affect the abundance and stability of these populations.

Current Status
There is no current total population estimate for shortnose sturgeon rangewide. Information on populations and metapopulations is presented below. In general, populations in the Northeast are larger and more stable than those in the Southeast (SSSRT, 2010). Population size throughout the species' range is considered to be stable; however, most riverine populations are below the historic population sizes and most likely are below the carrying capacity of the river (Kynard, 1996).

Population Structure
There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. There is a large gap in the middle of the species range with individuals present in the Chesapeake Bay separated from populations in the Carolinas by a distance of more than 400 km. Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

Developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see Grunwald et al., 2008; Grunwald et al., 2002; King et al., 2001; Waldman et al., 2002b; Walsh et al., 2001; Wirgin et al., 2009; Wirgin et al., 2002; SSSRT, 2010). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay, and Southeast groups function as metapopulations[24]. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations.

While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (see Walsh et al., 2001; Grunwald et al., 2002; Waldman et al., 2002; Wirgin et al., 2005). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

Summary of Status of Northeast Rivers
In NMFS' Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, and Delaware Rivers. Shortnose sturgeon are also known to occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems.

<u>Gulf of Maine Metapopulation</u>
Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Saco Rivers. Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski et al., 2011).

Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from the Bay to the Milford Dam. Shortnose

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[24] A metapopulation is a group of populations in which distinct populations occupy separate patches of habitat separated by unoccupied areas (Levins 1969). Low rates of connectivity through dispersal, with little to no effective movement, allow individual populations to remain distinct as the rate of migration between local populations is low enough not to have an impact on local dynamics or evolutionary lineages (Hastings and Harrison 1994). This interbreeding between populations, while limited, is consistent, and distinguishes metapopulations from other patchy populations.

sturgeon now are presumed to have access to their full historical range. Adult and large juvenile sturgeon have been documented to use the river. While potential spawning sites have been identified, no spawning has been documented. Foraging and overwintering are known to occur in the river. Nearly all prespawn females and males detected in the Penobscot River have been documented to return to the Kennebec or Androscoggin Rivers. Robust design analysis with closed periods in the summer and late fall estimated seasonal adult abundance ranging from 636-1285 (weighted mean), with a low estimate of 602 (95% CI: 409.6-910.8) and a high of 1306 (95% CI: 795.6-2176.4) (Fernandes, 2008; Fernandes et al., 2010; Dionne, 2010 in Maine DMR (2010)).

<u>Delaware River-Chesapeake Bay Metapopulation</u>
Shortnose sturgeon range from Delaware Bay up to at least Scudders Falls (river kilometer 223); there are no dams within the species' range on this river. The population is considered stable (comparing 1981-1984 to 1999-2003) at around 12,000 adults (Hastings et al., 1987 and ERC, 2006b). Spawning occurs primarily between Scudders Falls and the Trenton rapids. Overwintering and foraging also occur in the river. Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River. In Chesapeake Bay, shortnose sturgeon have most often been found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Kynard et al., 2016; SSSRT, 2010). Spells (1998), Skjeveland et al. (2000), and Welsh et al. (2002) all reported one capture each of adult shortnose sturgeon in the Rappahannock River. Recent documented use of Virginia waters of Chesapeake Bay is currently limited to two individual shortnose sturgeon: one captured in 2016 (Balazik, 2017) and a second sturgeon (a confirmed gravid female) caught in 2018 in the James River (Balazik, pers. comm. 2018). Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two prespawn females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population.

<u>Southeast Metapopulation</u>
There are no shortnose sturgeon between Maryland waters of the Chesapeake Bay and the Carolinas. Shortnose sturgeon are only thought to occur in the Cape Fear River and Yadkin-Pee Dee River in North Carolina and are thought to be present in very small numbers.

The Altamaha River supports the largest known population in the Southeast with successful self-sustaining recruitment. The most recent population estimate for this river was 6,320 individuals (95% CI = 4,387-9,249; DeVries, 2006). The population contains more juveniles than expected. Comparisons to previous population estimates suggest that the population is increasing; however, there is high mortality between the juvenile and adult stages in this river. This mortality is thought to result from incidental capture in the shad fishery, which occurs at the same time as the spawning period (DeVries, 2006).

The only available estimate for the Cooper River is of 300 spawning adults at the Pinoplis Dam spawning site (based on 1996-1998 sampling; Cooke et al., 2004). This is likely an underestimate of the total number of adults as it would not include non-spawning adults.

Estimates for the Ogeechee River were 266 (95%CI=236-300) in 1993 (Weber, 1996; Weber et al., 1998); a more recent estimate (sampling from 1999-2004; Fleming et al., 2003) indicates a population size of 147 (95% CI = 104-249). While the more recent estimate is lower, it is not significantly different from the previous estimate. Available information indicates the Ogeechee River population may be experiencing juvenile mortality rates greater than other southeastern rivers.

Spawning is also occurring in the Savannah River, the Congaree River, and the Yadkin-Pee Dee River. There are no population estimates available for these rivers. Occurrence in other southern rivers is limited, with capture in most other rivers limited to fewer than five individuals. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. In these river systems, shortnose sturgeon occur in nearshore marine, estuarine, and riverine habitat.

Threats

Because sturgeon are long-lived and slow growing, stock productivity is relatively low; this can make the species vulnerable to rapid decline and slow recovery (Musick, 1999). In well studied rivers (e.g., Hudson, upper Connecticut), researchers have documented significant year to year recruitment variability (up to 10 fold over 20 years in the Hudson and years with no recruitment in the CT). However, this pattern is not unexpected given the life history characteristics of the species and natural variability in hydrogeologic cues relied on for spawning.

The small amount of effective movement between populations means recolonization of currently extirpated river populations is expected to be very slow and any future recolonization of any rivers that experience significant losses of individuals would also be expected to be very slow. Despite the significant decline in population sizes over the last century, gene diversity in shortnose sturgeon is moderately high in both mtDNA (Quattro et al., 2002; Wirgin et al., 2005; Wirgin et al., 2000) and nDNA (King et al., 2001) genomes.

A population of sturgeon can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population), the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

All shortnose sturgeon populations are highly sensitive to increases in juvenile mortality that would result in reductions in the number of adult spawners (Anders et al., 2002; Gross et al., 2002; Secor, 2002). Populations of shortnose sturgeon that do not have reliable natural recruitment are at increased risk of experiencing population decline leading to extinction (Secor et al., 2002). Elasticity studies of shortnose sturgeon indicate that the highest potential for increased population size and stability comes from YOY and juveniles as compared to adults (Gross et al., 2002); that is, increasing the number of YOY and juveniles has a more significant long term impact to the population than does increasing the number of adults or the fecundity of adults.

The Shortnose Sturgeon Recovery Plan (NMFS, 1998) and the Shortnose Sturgeon Status Review Team's Biological Assessment of shortnose sturgeon (2010) identify habitat degradation or loss and direct mortality as principal threats to the species' survival. Natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon and include: poaching, bycatch in riverine fisheries, habitat alteration resulting from the presence of dams, in-water and shoreline construction, including dredging; degraded water quality which can impact habitat suitability and result in physiological effects to individuals including impacts on reproductive success; direct mortality resulting from dredging as well as impingement and entrainment at water intakes; and, loss of historical range due to the presence of dams. Shortnose sturgeon are also occasionally killed as a result of research activities. The total number of sturgeon affected by these various threats is not known. Climate change, particularly shifts in seasonal temperature regimes and changes in the location of the salt wedge, may impact shortnose sturgeon in the future (more information on Climate Change is presented in Section 5.0). More information on threats experienced in the action area is presented in the Environmental Baseline Section of this Opinion.

Recovery Plan
The 1998 Recovery Plan (NMFS, 1998) outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely; the minimum population size for each population has not yet been determined. The Recovery Outline contained within the 1998 Recovery Plan includes three major tasks: (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. In many rivers, particularly in the Southeast, habitat is compromised and continues to impact the ability of sturgeon populations to recover. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The loss of any population or metapopulation would result in the loss of biodiversity and would create (or widen) a gap in the species' range.

6.0 ENVIRONMENTAL BASELINE

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. (50 C.F.R. §402.02).

There are a number of existing activities that regularly occur in various portions of the action area, including operation of vessels and federal and state authorized fisheries. Other activities that occur occasionally or intermittently include scientific research, military activities, and geophysical and geotechnical surveys. There are also environmental conditions caused or exacerbated by human activities (i.e., water quality and noise) that may affect listed species in the action area. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strike, fisheries), whereas others result in non-lethal impacts or impacts that are indirect. For all of the listed species considered here, given their extensive movements in and out of the action area and throughout their range as well as the similarities of stressors throughout the action area and other parts of their range the status of the species in the action area is the same as the rangewide status presented in the *Status of the Species* section of this Opinion. Below, we describe the conditions of the action area, present a summary of the best available information on the use of the action area by listed species, and address the impacts to listed species of federal, state, and private activities in the action area that meet the definition of "environmental baseline." Consistent with that definition, future offshore wind projects, as well as activities caused by aspects of their development and operation, that are not the subjects of a completed Section 7 consultation (e.g., construction of the Atlantic Shores North project, Lease Area OCS-A 0549) are not in the Environmental Baseline for the Atlantic Shores South Offshore Wind project. Rather, as a Section 7 consultation is completed on a wind project, the effects of the action associated with that project would be considered in the Environmental Baseline for the next wind project in line for formal Section 7 consultation.

As described above in Section 3.4, the action area includes the WDA (i.e., the WFA and the cable routes to shore), project-related vessel routes in the identified portion of the U.S. EEZ along the Atlantic coast and the Gulf of Mexico, inclusive of the Delaware River and Chesapeake Bay entrance, and the geographic extent of effects caused by project-related activities in those areas. The Atlantic Shores South project area is located within multiple defined marine areas. The broadest area, the U.S. Northeast Shelf Large Marine Ecosystem, extends from the Gulf of Maine to Cape Hatteras, North Carolina (Kaplan 2011). The WDA is located within the Southern Mid-Atlantic Bight sub-region of the U.S. Northeast Shelf Ecosystem, which is distinct from other regions based on differences in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). The action area also overlaps with the Mid-Atlantic Bight, which is bounded by Cape Cod, MA to the north and Cape Hatteras, NC to the south. The physical oceanography of this region is influenced by the seafloor, freshwater input from multiple rivers and estuaries, large-scale weather patterns, and tropical or winter coastal storm events. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011). In areas off the coast of southern New Jersey, including the lease area, sea surface temperatures vary seasonally from 41°F (5°C) in winter to 73°F (23°C) in summer (NJDEP 2010, BOEM 2023). Seasonally, the Mid-Atlantic region experiences one of the largest transitions in stratification in any part of the ocean around the world, from the cold, well-mixed conditions in winter months to one of the largest top-to-bottom temperature differences in the summer (Castelao et al. 2010, Houghton et al. 1982, Miles et al. 2021). From spring through early summer, a strong thermocline develops across the length of the Mid-Atlantic Bight, isolating a continuous mid-shelf "cold pool" of water that extends from Nantucket to Cape Hatteras (Houghton et al. 1982, Kaplan 2011, Miles 2021). Through summer, the thermocline strengthens and the cold pool becomes more stable as a result of surface heating and freshwater runoff (Castelao et al. 2010). The stable summer cold pool is a relatively slow-moving feature, which moves back and forth between the coast and shelf in response to surface wind forcing during periods of upwelling and downwelling. During the fall, more frequent strong wind events and decreasing surface heat over increasingly shorter daily daylight hours shifts the balance between heat input and vertical mixing. This results in reduced stratification, which ultimately breaks down the cold pool (Bigelow 1933, Castelao et al 2010, Gong et al 2010, Lentz 2017, Lentz et al 2003, Miles et al 2021). These cold pool "seasons" of spring setup, summer stability, and fall breakdown are associated with and drivers of important biological and ecological processes, such as foraging and migration amongst marine vertebrates (Scales et al 2014).

Shelf currents in the Atlantic Shores South project area generally flow in a southerly direction (WHOI 2016). These bottom currents are influenced by local bathymetry and regional density gradients. Prominent bottom features of the Mid-Atlantic Bight include a series of ridges and troughs. On the OCS off the coast of New Jersey, the largest slopes are associated with sand ridges that are generally parallel to the shoreline and are actively modified by ocean currents (Goff et al 2005). Overall, the WDA exhibits a mostly flat, continuous seafloor which exhibits a very gentle (less than one degree) slope ranging from 17 meters to 37 meters below MLLW. Sand ripples are present throughout the area with shallow channel depressions present in the south of the WDA. Drag marks are present throughout, while more concentrated in the south, and are possibly due to heavy fishing activities (Guida et al 2017, Terrasound 2020). From the coastline to the WFA along the export cable routes, there is a shallow slope with an average gradient of less than 1°.

Surficial sediment mapping indicates a predominantly sand seafloor with decreasing grain size to the south throughout the Lease area (MARCO 2020). Sands with less than 5% gravel are predominant in the south portion of the lease area and near the export cable landfall locations (Atlantic Shores 2023). Gravel, gravel mixes, and gravelly sand predominate in the north and west portions of the Lease Area (Atlantic Shores 2023). Water depths range from 17-38 m in the lease area. From the coastline to the WFA along the export cable routes, water depths vary from 0-30 m. In the back bays, water depths are predominantly shallow (0.3-3 m) except in existing channels (BOEM 2023).

6.1 Summary of Information on Listed Large Whale Presence in the Action Area

North Atlantic right whale (Eubalaena glacialis)
North Atlantic right whale presence and behavior in the action area is best understood in the context of their range. North Atlantic right whales occur in the Northwest Atlantic Ocean from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters into Canadian waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence extending to the waters of Greenland and Iceland (Hayes et al. 2023; 81 FR 4837). The few published sightings of right whales in the Gulf of Mexico (Moore and Clark 1963, Schmidly and Melcher 1974, Ward Geiger et al. 2011) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern U.S. (Waring et al. 2009; 81 FR 4837). From 1963-2018, only five right whales were reported in the Gulf of Mexico, inclusive of a juvenile documented by a

fisherman off the coast of Florida in 2018. A mother-calf pair was reported off the Florida Coast in the Gulf of Mexico in 2020. Despite these occasional sightings, the Gulf of Mexico is not considered part of the species range (NMFS 2015; 81 FR 4837) and no right whales are expected to occur in the Gulf of Mexico portion of the action area.

In the late fall, pregnant female right whales move south to their calving grounds off Georgia and Florida, while the majority of the population likely remains on the feeding grounds or disperses along the eastern seaboard. There is at least one case of a calf apparently being born in the Gulf of Maine (Patrician et al. 2009), and another newborn was detected in Cape Cod Bay in 2013 (CCS, unpublished data, as cited in Hayes et al. 2022); however, calving outside of the southeastern U.S. is considered to be extremely rare. A review of visual and passive acoustic monitoring data in the western North Atlantic demonstrated nearly continuous year-round presence across their entire habitat range (for at least some individuals), including in waters previously thought to be used only seasonally by individuals migrating along the coast (e.g., waters off New Jersey and Virginia). This suggests that not all of the population undergoes a consistent annual migration (Bort et al. 2015, Cole et al. 2013, Davis et al. 2017, Hayes et al. 2020, Leiter et al. 2017, Morano et al. 2012, Whitt et al. 2013). Surveys have demonstrated several areas where North Atlantic right whales congregate seasonally, including 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; Massachusetts Bay; and the continental shelf south of New England (Brown et al. 2002, Cole et al. 2013, Hayes et al. 2020, Leiter et al. 2017). Several recent studies (Meyer-Gutbrod et al. 2015, 2021, Davis et al. 2017, Davies et al. 2019, Gowan et al. 2019, Simard et al. 2019) suggest spatiotemporal habitat-use patterns are in flux both with regards to a shift northward (Meyer-Gutbrod et al. 2021), changing migration patterns (Gowan et al. 2019), as well as changing numbers in existing known high-use areas (Davis et al. 2017, 2019, 2020).

North Atlantic right whales have been observed in or near state and federal waters off New Jersey during all four seasons; however, they are most common in spring when they are migrating north and in fall during their southbound migration (Kenney and Vigness-Raposa 2010, Roberts et al. 2016). These seasonal occurrence observations are aligned with more recent findings from aerial survey data collected between 2017-2020, where North Atlantic right whales were seen in adjacent state and federal waters off New York (up to 120 nm from the coast) during all seasons except summer (Zoidis et al. 2021). Digital aerial surveys were flown by APEM across the Atlantic Shores Lease Area from October 2020 to May 2021 in spring, fall and winter; no right whale sightings were recorded (BRI 2022). Two North Atlantic right whale sightings within the Atlantic Shores Couth lease area were reported between 15 and 25 January 2021 (NOAA Right Whale Sighting and Advisory System). A single North Atlantic right whale sighting occurred in the Study Corridor during Ocean Wind's Geotechnical 1A Survey in winter 2017-2018 (Smultea Environmental Sciences 2018), but no North Atlantic right whales were observed during the Ocean Wind Offshore Wind Farm Survey in summer 2017 in the Study Corridor (Alpine 2017); the Ocean Wind lease area is adjacent to the Atlantic Shores WDA.

In the past, occurrences of North Atlantic right whales in or near state and federal waters off New Jersey were known only from broader regional studies, opportunistic sightings, stranding records, and fine-scale studies in adjacent waters (e.g., CETAP 1982, Bowman et al. 2001, Knowlton et al. 2002, Biedron et al. 2009). Whitt et al. (2013) presents findings from the United States' first Ecological Baseline Study (EBS) specific to offshore wind planning for the New Jersey Department of Environmental Protection (NJDEP; GMI 2010); vessel and aerial surveys were carried out from the coast to 37 km offshore between January 2008 and December 2009. The area surveyed included the Atlantic Shores South WDA. Whitt et al. (2013) reports on the North Atlantic right whale sighting and aerial survey data collected in that study. In the two-year study period, four individual or pairs of North Atlantic right whales were observed, including one cow-calf pair. North Atlantic right whales were sighted in January (two juveniles), May (cow/calf pair), November, and December. Acoustic detections of vocalizing right whales were also recorded during the study period. Sightings occurred in water depths ranging from 17 to 26 m (mean: 22.5 m) and distances from shore ranged from 19.9 to 31.9 km (mean: 23.7 km; the survey transects went out to 37 km from shore). Initial sightings of females in November and December, and subsequent confirmations of these same individuals in southern calving grounds, illustrate that these waters are used for migration (Whitt et al. 2013). Whitt et al. (2013) reported behaviors for two juveniles that were sighted together exhibiting skim-feeding behavior (for approximately 1.5 hours) offshore of Barnegat Bay in January. Although feeding could not be confirmed as there was no evidence of prey patches and no prey sampling was conducted, the authors suggest that this observation indicates that at least occasional foraging in or near the WDA may occur when suitable prey in suitable densities is present. However, the WDA is not known to support aggregations of foraging right whales or sustained foraging over extended periods (i.e., days or weeks).

The Ecosystems and Passive Acoustic Monitoring (ECO-PAM) Project, a partnership between Orsted North America, Rutgers University, Woods Hole Oceanographic Institution (WHOI), and the University of Rhode Island, has deployed digital acoustic monitoring (DMON) moored buoys and autonomous underwater gliders in the Atlantic Shores South lease area (Orsted 2021). Since July 2020, WHOI has deployed DMON moored buoys 20 miles southeast of Atlantic City to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2021). Rutgers University has deployed autonomous underwater gliders in the WFA off New Jersey (Rutgers University 2021). These buoys and gliders have detected North Atlantic right whale calls in the vicinity of Atlantic Shores South WFA (WHOI 2021); no estimate of the number of individuals are available from this data but the acoustic detections confirm the presence of right whales in the New Jersey portion of the action area.

As described in the BA, the best available information regarding marine mammal densities in the portion of the action area encompassing the project area is provided by habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory (Roberts et al., 2016, 2022) This data was used to develop mean monthly density estimates for North Atlantic right whales in different parts of the action area; the mean density for each month was determined by calculating the unweighted mean of all 5- by 5-km grid cells partially or fully within the analysis polygon. Density estimates were produced for the lease area (plus a 3.9 km buffer), the nearshore areas where cofferdams will be installed, and the area where HRG surveys will take place. Density estimates for the lease area are presented below (JASCO 2023, summarized in Table 6.1 below).).

Table 6.1. Mean Monthly Density Estimates for North Atlantic right whales within a 3.9 km Buffer around the Lease Area

Species	Monthly Densities (animals per 100 km²)												
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annual Mean Density
North Atlantic right whale	0.069	0.074	0.062	0.046	0.010	0.003	0.001	0.001	0.002	0.008	0.026	0.042	0.022

Sources: Roberts et al. 2016, 2022

Density estimates indicate that February is the month with the highest density of right whales in the WDA and that North Atlantic right whales are most likely to occur in and around the lease area from November through May, with the highest probability of occurrence extending from January through April. Similar patterns are seen in the density estimates for the area surrounding the area where cofferdams will be installed and the HRG survey area.

In summary, we anticipate individual right whales to occur year round in the action area in both coastal, shallower waters as well as offshore, deeper waters. We expect these individuals to be moving throughout the action area, making seasonal migrations, occasionally foraging in parts of the action area when copepod patches of sufficient density are present, and calving during the winter months in southern waters of the action area (i.e., waters off Georgia and Florida that may be occasionally transited by project vessels transiting between the WDA and Corpus Christi, TX). As noted above, right whales are generally not expected to occur in the Gulf of Mexico with any presence being rare and limited to occasional, sporadic out of range individuals.

Nova Scotia Stock of Sei whale (Balaenoptera borealis)
In the action area, sei whales are expected to be present in the WDA, most likely in the deeper areas furthest from the coast, and may be present along the oceanic portions of all potential vessel transit routes. The presence and behavior of sei whales in the action area is best understood in the context of their range in the Atlantic, which extends from southern Europe/northwestern Africa to Norway in the east, and from the southeastern United States (or occasionally the Gulf of Mexico and Caribbean Sea; Mead 1977) to West Greenland in the west (Gambell 1977; Gambell 1985b; Horwood 1987). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. EEZ, the Gulf of Maine, Georges Bank, and south of New England (Halpin et al. 2009, Hayes et al. 2017, Hayes et al. 2020). Sei whales are very rare in the Gulf of Mexico with recent sightings limited to stranded individuals in the northern Gulf of Mexico (NMFS 2011). Sei whales are not documented as inhabitants of the Gulf of Mexico in NMFS' stock assessment reports (Waring 2016) and it is extremely unlikely that they would occur along the routes used by project vessels moving to or from ports in the Gulf of Mexico.

Sei whales occurring in the Mid-Atlantic Bight belong to the Nova Scotia stock (Hayes et al. 2020). They can be found in deeper waters of the continental shelf edge waters of the northeastern United States and northeastward to south of Newfoundland (Hain et al. 1985, Prieto et al., 2014). Documented sei whale sightings along the U.S. Atlantic Coast south of Cape Cod are relatively uncommon compared to other baleen whales (CETAP 1982; Kagueux et al. 2010; Hayes et al. 2020). Sei whale sightings in U.S. Atlantic waters are typically centered on mid-shelf and the shelf edge and slope (Olsen et al. 2009). Spring is the period of greatest sei whale abundance in New England waters, with sightings concentrated along the eastern margin of Georges Bank, into the Northeast Channel area, south of Nantucket, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (Hayes et al. 2022).

Sei whales often occur along the shelf edge to feed, but also use shallower shelf waters, particularly during certain years when oceanographic conditions force planktonic prey to shelf and inshore waters (Payne et al. 1990, Schilling et al. 1992, Waring et al. 2004). Although known to eat fish in other oceans, sei whales off the northeastern U.S. are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn et al. 2002, Hayes et al. 2017). These aggregations of prey are largely influenced by the dynamic oceanographic processes in the region. LaBrecque et al. (2015) defined a May to November feeding BIA for sei whales that extends from the 82-foot (25-m) contour off coastal Maine and Massachusetts east to the 656-foot (200-m) contour in the central Gulf of Maine, including the northern shelf break area of Georges Bank, the Great South Channel, and the southern shelf break area of Georges Bank from 328 to 6,562 feet (100–2,000 m). This feeding BIA does not overlap with the Atlantic Shores South WDA.

Sei whales may be present in the general vicinity of the WDA year-round but are most commonly present in the spring and summer (Hayes et al. 2020). No sei whales were recorded during EBS surveys or the BRI aerial surveys, but a fin or sei whale (could not be identified to species) was documented in the waters off New Jersey within a survey area that spanned from the coastline to approximately the 2,000 m depth contour during the summer 2016 and 2017 AMAPPS surveys (NJDEP 2010; NEFSC and SEFSC 2016, 2018). Sei whales were observed on the shelf and slope in the spring during aerial line-transect surveys in the New York Bight from 2017 to 2020 (Zoidis et al. 2021). This data from nearby areas informs our consideration of the presence of sei whales in the WDA.

Mean monthly density estimates of sei whales in and around the WDA were derived using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022). Model results indicate that sei whale density in the lease area plus a 3.9 km buffer in all directions is generally low, peaking in April at densities averaging 0.014 individuals per 100 km^2 (JASCO 2023 citing Roberts et al. 2016, 2022). Based on the information presented here, we expect sei whales to be at least occasionally present in the deeper water portions of the WDA and in the offshore portions of vessel routes between the WDA and ports in NJ and VA.

In summary, we anticipate individual or small groups of sei whales to occur in the offshore portions of the action area year round, with presence in more shallow, inshore waters and shelf portions of the action area, including the lease area, cable corridors, and vessel transit routes primarily in the spring and summer months. We expect individuals in the action area to be making seasonal migrations, and to be foraging when krill are present.

Sperm whale (Physeter macrocephalus)

In the action area, sperm whales are present in the more offshore portion of the WDA, in the Gulf of Mexico, and may be present along the oceanic portions of all potential vessel transit routes. Sperm whales in the Gulf of Mexico belong to the Northern Gulf of Mexico stock while sperm whales in the other portions of the action area belong to the North Atlantic stock (Hayes et al. 2020). Sperm whales are widely distributed throughout the deep waters of the North Atlantic, primarily along the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes et al., 2020). They are found at higher densities in areas such as the Bay of Biscay, to the west of Iceland, and towards northern Norway (Rogan et al. 2017) as well as around the Azores. This offshore distribution is more commonly associated with the Gulf Stream edge and other features (Waring et al. 1993, Waring et al. 2001). Calving for the species occurs in low latitude waters outside of the action area. Most sperm whales that are seen at higher latitudes are solitary males, with females generally remaining further south.

Northern Gulf of Mexico Stock

In the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico), systematic aerial and ship surveys indicate that sperm whales inhabit continental slope and oceanic waters where they are widely distributed and present year round (Hayes et al. 2021). The best abundance estimate (Nest) for the northern Gulf of Mexico sperm whale is 1,180 (CV=0.22). This estimate is from summer 2017 and summer/fall 2018 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ (Garrison et al. 2020). An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 March 2010 and ending 31 July 2014 (Litz et al. 2014; https://www.fisheries.noaa.gov/national/marine- life-distress/2010-2014-cetacean-unusual-mortality-event-northern-gulf-mexico). It included cetaceans that stranded prior to the Deepwater Horizon (DWH) oil spill, during the spill, and after. Exposure to the DWH oil spill was determined to be the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke et al. 2014; Venn-Watson et al. 2015; Colegrove et al. 2016; DWH NRDAT 2016 in Hayes et al. 2021). Sperm whales in the Gulf of Mexico experienced increased mortality related to oil exposure resulting from the DWH incident (Hayes et al. 2021).

North Atlantic Stock

Sperm whales are widely distributed throughout the deep waters of the North Atlantic, primarily along the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes et al., 2020). They are found at higher densities in areas such as the Bay of Biscay, to the west of Iceland, and towards northern Norway (Rogan et al. 2017) as well as around the Azores. This offshore distribution is more commonly associated with the Gulf Stream edge and other features (Waring et al. 1993, Waring et al. 2001). Calving occurs in low latitude waters outside of the action area. Most sperm whales that are seen at higher latitudes are solitary males, with females generally remaining further south.

In the U.S. Atlantic EEZ waters, there appears to be a distinct seasonal distribution pattern (CETAP 1982, Scott and Sadove 1997). In spring, the center of distribution shifts northward to east of Delaware and Virginia and is widespread throughout the central portion of the Mid-Atlantic Bight and the southern portion of Georges Bank. In summer, the distribution of sperm whales includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100-m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level. In winter, sperm whales are concentrated east and northeast of Cape Hatteras.

The average depth of sperm whale sightings observed during the CeTAP surveys was 5,880 ft. (1,792 m) (CETAP 1982). Female sperm whales and young males usually inhabit waters deeper than 3,280 ft. (1,000 m) and at latitudes less than 40° N (Whitehead 2002). Sperm whales feed on larger organisms that inhabit the deeper ocean regions including large- and medium-sized squid, octopus, and medium-and large-sized demersal fish, such as rays, sharks, and many teleosts (NMFS 2015; Whitehead 2002). Although primarily a deep-water species, sperm whales are known to visit shallow coastal regions when there are sharp increases in bottom depth where upwelling occurs resulting in areas of high planktonic biomass (Clarke 1956, Best 1969, Clarke et al. 1978, Jaquet 1996).

Sperm whales may be present in the general vicinity of the WDA, but are considered uncommon near the Atlantic Shores South WDA. During the summer 2017 AMAPPS aerial survey, a sperm whale was documented in the waters off New Jersey, in the deeper portion of the shelf edge (NEFSC and SEFSC 2018). During the Northern leg of the 2021 AMAPPS shipboard survey, sperm whales were among the most common large whale species detected during acoustic monitoring efforts in the survey area which ranged from south of Massachusetts to east of Virginia in waters beyond the 100 m depth contour. Until recently, there had been no recorded strandings of sperm whales in New Jersey since 2008 (Henry et al. 2020). There were four sperm whale strandings along the New Jersey/New York coastline in 2022, three of which occurred in December (MMSC 2023). No evidence of human interactions was detected for these strandings.

As part of the application for an MMPA ITA for the Atlantic Shores project, JASCO (2023) used data from Roberts et al. (2016, 2022) to calculate mean monthly density estimates within 3.9 km of the Atlantic Shores South lease area. In the lease area, monthly density of sperm whales ranges from 0.000-0.0007 sperm whales/100 km2, with the lowest density in August to October, and with the highest density in April.

In summary, individual adult sperm whales are anticipated to occur infrequently in deeper, offshore waters of the North Atlantic portion of the action area primarily in summer and fall months, with a small number of individuals potentially present year round. These individuals are expected to be moving in or near the WDA as they make seasonal migrations, and to be foraging along the shelf break. As sperm whales typically forage at deep depths (500-1,000 m) (NMFS 2018) well beyond that of the lease area, foraging is not expected to occur in WDA. Additionally, sperm whales may occur along the vessel transit routes south of the WDA, with presence most likely in more offshore waters. Sperm whales are also present in the Gulf of Mexico year round.

Western North Atlantic stock of fin whales (Balaenoptera physalus)

In the action area, fin whales are present in the WDA and may be present along the oceanic portions of a majority of vessel transit routes. Fin whale presence and behavior in the action area is best understood in the context of their range. Fin whale presence in the North Atlantic is limited to waters north of Cape Hatteras, NC. In general, fin whales in the central and eastern

Atlantic tend to occur most abundantly over the continental slope and on the shelf seaward of the 200-m isobath (Rørvik et al. 1976 in NMFS 2010). In contrast, off the eastern United States they are centered along the 100-m isobath but with sightings well spread out over shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1987; Hain et al. 1992). Fin whales do not occur in the Gulf of Mexico.

Fin whales occurring in the Mid-Atlantic belong to the western North Atlantic stock (Hayes et al. 2019). They are typically found along the 328-foot (100-meter) isobath but also in shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1986). Fin whales are migratory, moving seasonally into and out of feeding areas, but the overall migration pattern is complex and specific routes are unknown (NMFS 2018a). Fin whales are believed to use the North Atlantic water primarily for feeding and more southern waters for calving. Movement of fin whales from the Labrador/Newfoundland region south into the West Indies during the fall have been reported (Clark 1995). Neonate strandings along the U.S. Mid-Atlantic coast from October through January indicate a possible offshore calving area (Hain et al. 1992). The species occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally. Thus, their movements overall are patterned and consistent, but distribution of individuals in a given year may vary according to their energetic and reproductive condition, and climatic factors (NMFS 2010).

The northern Mid-Atlantic Bight represents a major feeding ground for fin whales as the physical and biological oceanographic structure of the area aggregates prey. This feeding area extends in a zone east from Montauk, Long Island, New York, to south of Nantucket (LaBrecque et al. 2015, Kenney and Vigness-Raposa 2010; NMFS 2010a) and is a location where fin whales congregate in dense aggregations and sightings frequently occur (Kenney and Vigness-Raposa 2010). Fin whales in this area feed on krill (*Meganyctiphanes norvegica* and *Thysanoessa inermis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes* spp.) (Borobia et al. 1995) by skimming the water or lunge feeding. This area is used extensively by feeding fin whales from March to October. Several studies suggest that distribution and movements of fin whales along the east coast of the United States is influenced by the availability of sand lance (Kenney and Winn 1986, Payne 1990).

Acoustic studies in Estabrook et al. (2019, 2020) detected fin whales in the New York Bight every month of the year in their study period from 2017 to 2019. The results of these acoustic studies are consistent with the observations in Zoidis et al. (2021) where fin whales were sighted at least once in each month of the calendar year across the 3 years and in each survey season, throughout the study area across all habitat zones. While these studies were north of the WDA, given the geographic proximity to the WDA they are informative of potential presence of fin whales in the WDA. Based on the occurrence of a cow-calf pair observed in August 2008, results from the EBS provide support for the possibility of nearshore waters off New Jersey serving as nursery habitat (NJDEP 2010, Whitt et al. 2015). Ten fin whales are reported to have stranded along the New Jersey coast from 2008 to 2017 (Hayes et al. 2020; Henry et al. 2020). Of these, nine were determined to be the result of vessel strikes and one ruled an entanglement.

Sightings data from the EBS (NJDEP 2010, Whitt et al. 2015) in state and federal waters off New Jersey indicate that fin whales are common in and near the Atlantic Shores South WDA during all seasons. AMAPPS surveys detected fin whales in the Wind Energy Areas in the fall 2012 aerial, spring 2013 aerial, spring 2014 aerial, spring and summer 2017 aerial, winter 2018 aerial, and summer 2016 shipboard surveys (NEFSC and SEFSC 2012, 2013, 2014, 2016, 2018, 2019, 2022). Fin whales were also recorded in the adjacent Ocean Wind WDA during the summer 2017 HRG survey (Alpine 2017b) and during the Geotechnical 1A Survey in winter 2017–2018 (Smultea Environmental Sciences 2018). One fin whale was sighted during the 8 days of digital aerial surveys in the Atlantic Shores lease area (BRI 2022, COP Appendix II-L2).

Mean monthly density estimates of fin whales in the project area were derived using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022, as reported in JASCO 2023). Model results indicate that fin whale density in the lease area is considerably variable between months with peaks in December and January with densities ranging from 0.028 (June) to 0.178 (January) individuals per 100 km^2 throughout the year. Seasonal estimates calculated for fin whales in the NJ WEA in Palka et al. (2017) are consistent with these results as the authors described low numbers during the spring, summer, and fall, with peaks in cooler months.

Because fin whales have a worldwide distribution and are largely open-ocean dwellers, we expect fin whales to occur along all portions of the oceanic vessel transit route to Portsmouth, VA and along only a portion of the vessel transit route to Corpus Christi, TX. This is because fin whales are common in state and federal waters principally from Cape Hatteras, NC northward.

In summary, we anticipate individual fin whales to occur in the WDA year-round, with the possibility that monthly density peaks will vary inter-annually. We expect these individuals to be making seasonal coastal migrations, and to be foraging during spring and summer months. Fin whales occur year-round in a wide range of latitudes and longitudes, thus they may be present along the vessel transit routes north of Cape Hatteras, NC year round. No fin whales are anticipated in the Gulf of Mexico portion of the action area.

6.2 Summary of Information on Listed Sea Turtles in the Action Area

Four ESA listed species of sea turtles (leatherback sea turtles, North Atlantic DPS of green sea turtles, Northwest Atlantic Ocean DPS of loggerhead sea turtles, Kemp's ridley sea turtles) make seasonal migrations into the U.S. Mid-Atlantic and are present in portions of the action area. Individuals from all four species are seasonally present in the WDA, typically from late spring/early summer through the fall; these species are also seasonally present in the coastal and oceanic waters that may be transited by project vessels traveling to ports in New Jersey, including lower Delaware Bay. Sea turtles are present year round in the South Atlantic and Gulf of Mexico and their range overlaps with the coastal and oceanic waters that may be transited by project vessels traveling to/from Corpus Christi, TX.

The four species of sea turtles considered here are highly migratory. One of the main factors influencing sea turtle presence in mid-Atlantic waters and north is seasonal temperature patterns (Ruben and Morreale 1999) as waters in these areas are not warm enough to support sea turtle presence year round. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas to foraging grounds as water temperatures warm in the spring. The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Braun-McNeill and Epperly 2002, Ceriani et al. 2012, Griffin et al. 2013, James et al. 2005b, Mansfield et al. 2009, Morreale and Standora 2005, Morreale and Standora 1998, NEFSC and SEFSC 2011, Shoop and Kenney 1992, TEWG 2009, Winton et al. 2018). Water temperatures too low or too high may affect feeding rates and physiological functioning (Milton and Lutz 2003); metabolic rates may be suppressed when a sea turtle is exposed for a prolonged period to temperatures below 8-10°C (George 1997, Milton and Lutz 2003, Morreale et al. 1992). That said, loggerhead sea turtles have been found in waters as low as 7.1-8°C (Braun-McNeill et al. 2008, Smolowitz et al. 2015, Weeks et al. 2010). However, in assessing critical habitat for loggerhead sea turtles, the review team considered the water-temperature habitat range for loggerheads to be above 10° C (NMFS 2013). Sea turtles are most likely to occur in the action area when water temperatures are above this temperature, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records). Given the warmer water temperatures, sea turtles are present in waters off the U.S. south Atlantic and in the Gulf of Mexico year round.

AMAPPS aerial abundance surveys in summer 2021 indicate that loggerhead and leatherback turtles are relatively common in waters of the southern Mid-Atlantic Bight while Kemp's ridley turtles and green turtles are less common (NEFSC and SEFSC 2022). Sea turtle nesting does not occur in New Jersey, and there are no nesting beaches or other critical habitats in the vicinity of the project area (GARFO 2021). For this reason, sea turtles in the lease area are adults or juveniles; due to the distance from any nesting beaches, no hatchlings occur in the lease area.

Sea turtles feed on a variety of both pelagic and benthic prey, and change diets through different life stages. Adult loggerhead and Kemp's ridley sea turtles are carnivores that feed on crustaceans, mollusks, and occasionally fish, green sea turtles are herbivores and feed primarily on algae, seagrass, and seaweed, and leatherback sea turtles are pelagic feeders that forage throughout the water column primarily on gelatinivores. As juveniles, loggerhead and green sea turtles are omnivores (Wallace et al. 2009, Dodge et al. 2011, BA - Eckert et al. 2012, https://www.seeturtles.org/sea-turtle-diet, Murray et al 2013, Patel et al. 2016). The distribution of pelagic and benthic prey resources is primarily associated with dynamic oceanographic processes, which ultimately affect where sea turtles forage (Polovina et al. 2006). During late-spring, summer, and early-fall months when water temperatures are suitable, the physical and biological structure of both the pelagic and benthic environment in the lease area and cable corridor provide habitat for both the four species of sea turtles in the region as well as their prey.

Additional species-specific information is presented below. It is important to note that most of these data sources report sightings data that is not corrected for the percentage of sea turtles that were unobservable due to being under the surface. As such, many of these sources represent a minimum estimate of sea turtles in the area.

Leatherback sea turtles
Leatherbacks are a predominantly pelagic species that ranges into cooler waters at higher latitudes than other sea turtles; their large body size makes the species easier to observe in aerial

and shipboard surveys. The CETAP regularly documented leatherback sea turtles on the OCS between Cape Hatteras and Nova Scotia during summer months in aerial and shipboard surveys conducted from 1978 through 1988. The greatest concentrations were observed between Long Island and the Gulf of Maine (Shoop and Kenney 1992). AMAPPS surveys conducted from 2010 through 2021 routinely documented leatherbacks in the NJ WEA and surrounding areas during summer months (NEFSC and SEFSC 2018, 2022; Palka 2021).

During NJDEP (2010) aerial and shipboard surveys for marine mammals and sea turtles, sightings included a total of 12 leatherback sea turtles in waters ranging from 59 to 98 feet (18 to 30 meters) deep, with a mean depth of 79 feet (24 meters). Sightings were recorded from 6.4 to 22.5 miles (5.6 to 19.6 nm, 10.3 to 36.2 km) from shore, with a mean distance of 17.8 miles (15.5 nm, 28.6 km). The sea surface temperatures associated with leatherback sea turtle sightings ranged from 64.6 to 68.5°F (18.1 to 20.3°C), with a mean temperature of 66.2°F (19.0°C). Migrating leatherback sea turtles usually start arriving along the New Jersey coast in late spring/early summer (Shoop and Kenney 1992; James et al. 2006). Over the course of the eight aerial digital survey days flown over the lease area (BRI 2022), 3 leatherbacks were identified. All sightings were during the fall. Density of leatherback sea turtles off the New Jersey coast during summer, the season with the highest density, ranged from 1.889 to 4.135 animals per 100 km^2 in reports provided by the U.S. Navy (U.S. Navy 2007).

Key foraging destinations include, among others, the eastern coast of the United States (Eckert et al. 1998, 2012). Satellite tagging studies provide information on leatherback sea turtle behavior and movement in the action area. These studies show that leatherback sea turtles move throughout most of the North Atlantic from the equator to high latitudes. Based on tracking data for leatherbacks tagged off North Carolina (n=21), many of the tagged leatherbacks spent time in shelf waters from North Carolina, up the Mid-Atlantic shelf and into southern New England and the Gulf of Maine. After coastal residency, some leatherbacks undertook long migrations while tagged. Some migrated far offshore of the Mid-Atlantic, past Bermuda, even as far as the Mid-Atlantic Trench region. Others went towards Florida, the Caribbean, or Central America (Palka et al. 2021). This data indicates that leatherbacks are present throughout the action area at all depths of the water column and may be present along the vessel transit routes from the South Atlantic and Gulf of Mexico.

The Marine Mammal Stranding Center (MMSC) in New Jersey rescued 177 leatherback turtles between 1995 and 2005 and another 10 between 2013 and 2018 (MMSC 2023). Of the turtles rescued in this time interval, 14 percent had been struck by boat propellers, 8 percent had an interaction with fishing gear, and 2 percent had been struck by a boat (Schoelkopf 2006). From 2010 through 2023, the Sea Turtle Stranding and Salvage Network (STSSN) reported 15 offshore and 6 inshore leatherback sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021b. STSSN[25]).

As described in the BA (Table 3-24), the best available information regarding densities for sea turtles in the WDA were derived from at-sea densities of sea turtles using data from a multi-year series of seasonal aerial surveys conducted in the adjacent New York Bight region (Normandeau

[25] https://connect.fisheries.noaa.gov/content/cb3f4647-9e4f-4f3d-9edf-e7a87a1feef6/ Last accessed 10/12/2023

Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Abundance estimates were corrected to represent the abundance in the entire offshore planning area and then scaled by the full offshore planning area to obtain a density in units of animals per km^2. Model results indicate that leatherback sea turtle density in the WDA is highest in the fall (0.789 animals/100 km^2), followed by summer (0.331 animals/100 km^2), and no leatherback sea turtles expected in spring or winter.

Sasso et al. (2021) presents information on the use of the Gulf of Mexico by leatherbacks. Individuals are present year round with highest abundance during the summer and early autumn as post-nesting turtles enter the Gulf from Caribbean nesting beaches during the summer and move to the Caribbean in the late fall. The summer and early fall period coincides with the period of greatest abundance of the leatherback's preferred jellyfish prey. The northeastern Gulf of Mexico off the Florida Panhandle and the southeastern Gulf of Mexico in the Bay of Campeche off the state of Tabasco, Mexico have been identified as primary foraging areas.

Based on the information presented here, we anticipate leatherback sea turtles to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between May and November. Leatherbacks are also expected along the vessel transit routes used by project vessels transiting to and from ports in the South Atlantic with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

Northwest Atlantic DPS of Loggerhead sea turtles
The loggerhead sea turtle is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, the Bahamas archipelago (Dow et al. 2007), and eastward to West Africa, the western Mediterranean, and the west coast of Europe (NMFS and USFWS 2008). The range of the Northwest Atlantic DPS is the Northwest Atlantic Ocean north of the equator, south of 60° N. Lat., and west of 40° W. Long. Northwest Atlantic DPS loggerheads occur in the oceanic portions of the action area west of 40°W, inclusive of the Gulf of Mexico.

Extensive tagging results suggest that tagged loggerheads occur on the continental shelf along the United States Atlantic from Florida to North Carolina year-round but also highlight the importance of summer foraging areas on the Mid-Atlantic shelf, which includes the WDA (Winton et al. 2018). The STSSN reported 79 offshore and 99 inshore loggerhead sea turtle strandings between 2018 and 2022 in New Jersey, the highest number among all turtle species reported (NMFS STSSN 2023). In the shelf waters off of New Jersey, loggerhead sea turtles can be found seasonally, primarily in the summer and autumn months when surface temperatures range from 44.6ºF to 86ºF (7ºC to 30ºC) (Kenney and Vigness-Raposa 2010; Shoop and Kenney 1992). The NJDEP (2010) aerial and shipboard surveys recorded a total of 615 loggerhead sea turtle sightings between January 2008 and December 2009. The loggerhead sea turtle was the second most frequently sighted species during the survey, and the vast majority of sightings were during the summer (NJDEP 2010).

During the CETAP surveys, one of the largest observed aggregations of loggerheads was documented in shallow shelf waters northeast of Long Island (Shoop and Kenney 1992), north of the action area; however, this data is informative of loggerhead habitat use in the action area. Loggerheads were most frequently observed in areas ranging from 72 to 160 feet (22 and 49 m) deep. Over 80% of all sightings were in waters less than 262 feet (80 m), suggesting a preference for relatively shallow OCS habitats (Shoop and Kenney 1992). Juvenile loggerheads are prevalent in the nearshore waters of Long Island from July through mid-October (Morreale et al. 1992; Morreale and Standora 1998), accounting for more than 50% of live strandings and incidental captures (Morreale and Standora 1998).

In the summer of 2010, as part of the AMAPPS project, the NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead sea turtles in the portion of the northwestern Atlantic continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada (NMFS and SEFSC 2011b). The abundance estimates were based on data collected from an aerial line-transect sighting survey as well as satellite tagged loggerheads. The preliminary regional abundance estimate was about 588,000 individuals (approximate inter-quartile range of 382,000-817,000) based on only the positively identified loggerhead sightings, and about 801,000 individuals (approximate inter-quartile range of 521,000-1,111,000) when based on the positively identified loggerheads and a portion of the unidentified sea turtle sightings (NMFS 2011b). The loggerhead was the most frequently observed sea turtle species in 2010 to 2017 AMAPPS aerial surveys of the Atlantic continental shelf. Large concentrations were regularly observed in proximity to the NJ WEA (Palka et al. 2021).

Barco et al. (2018) estimated loggerhead sea turtle abundance and density in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay using data from 2011-2012. During aerial surveys off Virginia and Maryland, loggerhead sea turtles were the most common turtle species detected, followed by greens and leatherbacks, with few Kemp's ridleys documented. Density varied both spatially and temporally. Loggerhead abundance and density estimates in the ocean were higher in the spring (May-June) than the summer (July-August) or fall (September-October). Ocean abundance estimates of loggerheads ranged from highs of 27,508-80,503 in the spring months of May-June to lows of 3,005-17,962 in the fall months of September-October (Barco et al. 2018).

AMAPPS data, along with other sources, have been used in recent modelling studies. Winton et al. (2018) modelled the spatial distribution of satellite-tagged loggerhead sea turtles in the Western North Atlantic. The Mid-Atlantic Bight was identified as an important summer foraging area and the results suggest that the area may support a larger proportion of the population, over 50% of the predicted relative density of loggerheads north of Cape Hatteras from June to October (NMFS 2019a, Winton et al. 2018). Using satellite telemetry observations from 271 large juvenile and adult sea turtles collected from 2004 to 2016, the models predicted that overall densities were greatest in the shelf waters of the U.S. Atlantic coast from Florida to North Carolina. Tagged loggerheads primarily occupied the continental shelf from Long Island, New York to Florida, with some moving offshore. Monthly variation in the Mid-Atlantic Bight indicated migration north to the foraging grounds from March to May and migration south from November to December. In late spring and summer, predicted densities were highest in the shelf waters from Maryland to New Jersey. In the cooler months, the predicted densities in the Mid-Atlantic Bight were higher offshore (Winton et al. 2018). South of Cape Hatteras, there was less seasonal variability and predicted densities were high in all months. Many of the individuals tagged in this area remained in the general vicinity of the tagging location. The authors did caution that the model was driven, at least in part, by the weighting scheme chosen, is reflective only of the tagged population, and has biases associated with the non-random tag deployment. Most loggerheads tagged in the Mid-Atlantic Bight were tagged in offshore shelf waters north of Chesapeake Bay in the spring. Thus, loggerheads in the nearshore areas of the Mid-Atlantic Bight may have been under-represented (Winton et al. 2018).

To better understand loggerhead behavior on the Mid-Atlantic foraging grounds, Patel et al. (2016) used a remotely operated vehicle (ROV) to document the feeding habitats (and prey availability), buoyancy control, and water column use of 73 loggerheads recorded from 2008-2014. When the mouth and face were in view, loggerheads spent 13% of the time feeding on non-gelatinous prey and 2% feeding on gelatinous prey. Feeding on gelatinous prey occurred near the surface to depths of 52.5 ft. (16 m). Non-gelatinous prey were consumed on the bottom. Turtles spent approximately 7% of their time on the surface (associated with breathing), 42% in the near surface region, 44% in the water column, 0.4% near bottom, and 6% on bottom. When diving to depth, turtles displayed negative buoyancy, making staying at the bottom easier (Patel et al. 2016).

Patel et al. (2018) evaluated temperature-depth data from 162 satellite tags deployed on loggerhead sea turtles from 2009 to 2017 when the water column is highly stratified (June 1 – October 4). Turtles arrived in the Mid-Atlantic Bight in late May as the Cold Pool formed and departed in early October when the Cold Pool started to dissipate. The Cold Pool is an oceanographic feature that forms annually in late May. During the highly stratified season, tagged turtles were documented throughout the water column from June through September. Fewer bottom dives occurred north of Hudson Canyon early (June) and late (September) in the foraging season (Patel et al. 2018).

The MMSC in New Jersey rescued an average of 47 loggerhead turtles each year between 1995 and 2005 and another 138 between 2013 and 2018 (MMSC 2023). Of the loggerhead turtles rescued between 1995 and 2005, 16 percent had been struck by propellers, 3.9 percent had evidence of boat collisions, and 3.7 percent had evidence of fisheries interactions (Schoelkopf 2006). From 2010 through 2020, STSSN reported 139 offshore and 74 inshore loggerhead sea turtle strandings within Zone 39, which encompasses southern New Jersey, with 45 additional strandings reported by the STSSN from 2021 through October, 2023 (NMFS 2021b, STSSN[26]). Loggerheads are stranded far more often than other sea turtles in New Jersey (NMFS 2021b), as they have a higher relative abundance.

Over the course of the eight aerial digital survey days flown over the lease area (BRI 2022), 3 loggerheads were identified. All sightings were during the fall. The density of loggerhead sea turtles in the waters off New Jersey during summer, the season with the highest density, has been estimated to range from 1.631 to 9.881 animals per 38.6 mi^2 (100 km^2) (U.S. Navy 2007). Density estimates of loggerhead sea turtles in the project area were also derived using at-sea-density data for sea turtles in the adjacent waters of the New York Bight (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Model results indicate that loggerhead sea turtle density in the WDA is highest in the summer (26.799 animals/100 km^2), followed by spring (0.254 animals/100 km^2), then fall (0.19 animals/100 km^2), and winter (0.025 animals/100 km^2); as noted in the BA, this is currently the best available data for density of sea

[26] https://connect.fisheries.noaa.gov/content/cb3f4647-9e4f-4f3d-9edf-e7a87a1feef6/ Last accessed 10/12/2023

turtles in the WDA.

Based on the information presented here, we anticipate loggerheads from the Northwest Atlantic DPS to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between May and November. Loggerheads are also expected along the vessel transit routes used by project vessels transiting to southern ports with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

Kemp's ridley sea turtles
Kemp's ridleys are distributed throughout the Gulf of Mexico and U.S. Atlantic coastal waters, from Florida to New England. Adult Kemp's ridleys primarily occupy nearshore coastal (neritic) habitats. Many adult Kemp's ridleys remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS, USFWS, and SEAMARNAT 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 m) deep (Landry and Seney 2008; Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters.

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico and along the United States Atlantic coast from southern Florida to the Mid-Atlantic and New England. In addition, the NEFSC caught a juvenile Kemp's ridley during a recent research project in deep water south of Georges Bank (NEFSC unpublished data, as cited in NMFS [2020a]). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 m) deep (Seney and Landry 2008; Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters.

Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Long Island Sound and Cape Cod Bay during summer and autumn foraging (NMFS, USFWS and SEAMARNAT 2011). Visual sighting data are limited because this small species is difficult to observe using aerial survey methods (Kraus et al. 2016), and most surveys do not cover its preferred shallow bay and estuary habitats. The MMSC in New Jersey rescued an average of 45 Kemp's ridley turtles each year between 1995 and 2005, of which 18% had become impinged on power plant grates, 4% had been struck by boat propellers, and 20% showed signs of other impacts (NJDEP 2006). From 2010 through 2023, the STSSN reported 11 offshore and 7 inshore Kemp's ridley sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021b, STSSN[27]).

The density of Kemp's ridley sea turtles off the New Jersey coast during summer, the season with the highest density, ranges from 0 to 0.0186 animals per 38.6 mi^2 (100 km^2) (U.S. Navy 2007). Twenty-two Kemp's ridleys were identified in 8-day aerial surveys of the Atlantic Shores WDA (BRI 2022); all were detected in the fall. Density estimates of Kemp's ridley sea turtles in the WDA were derived using at-sea-density data for sea turtles in the adjacent waters of the New York Bight (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Model

[27] https://connect.fisheries.noaa.gov/content/cb3f4647-9e4f-4f3d-9edf-e7a87a1feef6/ Last accessed 10/12/2023

results indicate that Kemp's ridley sea turtle density in the WDA is highest in the summer (0.991 animals/100 km^2), followed by fall (0.19 animals/100 km^2), then spring (0.05 animals/100 km^2), and no Kemp's ridley sea turtles expected in winter.

Based on the information presented here, we anticipate Kemp's ridley turtles to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between May and November. We expect the highest likelihood of occurrence to be in coastal nearshore areas adjacent to Atlantic City and Barnegat Bay, where the project's export cable system will make landfall, as Kemp's ridley sea turtles are known to seek protected shallow-water habitats. Kemp's ridleys are also expected along the vessel transit routes used by project vessels transiting to southern ports with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

North Atlantic DPS of Green sea turtles
Most green turtles spend the majority of their lives in coastal foraging grounds. These areas include fairly shallow waters both open coastline and protected bays and lagoons. In addition to coastal foraging areas, oceanic habitats are used by oceanic-stage juveniles, migrating adults, and, on some occasions, by green turtles that reside in the oceanic zone for foraging. Green sea turtles are likely to be present seasonally in the WDA and to occur in portions of the vessel traffic component of the action area. Green sea turtles are present year round in the Gulf of Mexico and nesting occurs at some Gulf of Mexico beaches (NMFS and USFWS 2007).

This species is typically observed in U.S. waters in the Gulf of Mexico or coastal waters south of Virginia (USFWS 2021). Juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (NMFS and USFWS 1991), including the waters of Long Island Sound and Cape Cod Bay (CETAP 1982). Five green turtle sightings were recorded off the Long Island shoreline in aerial surveys conducted from 2010 to 2013 (NEFSC and SEFSC 2018). Green sea turtles were also positively identified in 2010 to 2017 AMAPPS aerial surveys of the Atlantic continental shelf. Large concentrations were regularly observed in proximity to the NJ WEA, with most sightings occurring during summer between North Carolina and New York, along the continental shelf (Palka et al. 2021).

The STSSN rescued eight green sea turtles between 1995 and 2005, of which six had evidence of human interactions with fishing activities, boat strikes, and impingement on a power plant grate (NJDEP 2006). From 2010 to 2023, the STSSN reported 9 offshore and 6 inshore green sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021b STSSN[28]).These and other sources of information indicate that green sea turtles occur periodically in shallow nearshore waters of Mid-Atlantic Bight, but their presence offshore in the Lease Area is also possible.

The density of green sea turtles off the New Jersey coast during summer, the season with the highest density, has been estimated to range from 0 to 2.338 animals per 38.6 mi^2 (100 km^2) (U.S. Navy 2007). Density estimates of green sea turtles in the project area were also derived using at-sea-density data for sea turtles in the adjacent waters of the New York Bight

[28] https://connect.fisheries.noaa.gov/content/cb3f4647-9e4f-4f3d-9edf-e7a87a1feef6/ Last accessed 10/12/2023

(Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Model results indicate that green sea turtle density in the offshore project area is generally low and limited to the summer (0.038 animals/100 km^2), with no green sea turtles expected in spring, fall, or winter.

Based on the information presented here, we anticipate green sea turtles to occur in the WDA during the warmer months, typically between May and November. Green sea turtles are also expected along the vessel transit routes used by project vessels transiting to the southern ports, with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

6.3 Summary of Information on Listed Marine Fish Presence in the Action Area

Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus)
Adult and subadult (not sexually mature, but have left their natal rivers; typically less than 150cm in total length,) Atlantic sturgeon from all five DPSs undertake seasonal, nearshore (i.e., typically depths less than 50 meters), coastal marine migrations along the United States eastern coastline including in waters of southern New England (Dunton et al. 2010, Erickson et al. 2011). Given their anticipated distribution in depths primarily 50 m and less, Atlantic sturgeon are not expected to occur in the deep, open-ocean portion of the action area that will be transited by project vessels traveling to/from distant ports. In addition to at least occasional presence in the WDA, Atlantic sturgeon may also occur along the transit routes to the Paulsboro Marine Terminal, Repauno Terminal, and New Jersey Wind Port (transiting Delaware Bay and the lower Delaware River) and Portsmouth, VA) (transiting channels within the Chesapeake Bay entrance). Atlantic sturgeon do not occur in the Gulf of Mexico.

Atlantic sturgeon demonstrate strong spawning habitat fidelity and extensive migratory behavior (Savoy et al. 2017). Adults and subadults migrate extensively along the Atlantic coastal shelf (Erickson et al. 2011; Savoy et al. 2017), and use the coastal nearshore zone to migrate between river systems (ASSRT 2007; Eyler et al. 2004). Erickson et al. (2011) found that adults remain in nearshore and shelf habitats ranging from 6 to 125 feet (2 to 38 m) in depth, preferring shallower waters in the summer and autumn and deeper waters in the winter and spring. Data from capture records, tagging studies, and other research efforts (Damon-Randall et al. 2013; Dunton et al. 2010; Stein et al. 2004a, 2004b; Zollett 2009) indicate the potential for occurrence in the action area during all months of the year. Individuals from every Atlantic sturgeon DPS have been captured in the Virginian marine ecoregion (Cook and Auster 2007; Wirgin et al. 2015a, 2015b), which extends from Cape Cod, Massachusetts, to Cape Lookout, North Carolina.

Based on tag data, sturgeon migrate to southern waters (e.g. off the coast of North Carolina and Virginia) during the fall, and migrate to more northern waters (e.g. off the coast of New York, southern New England, as far north as the Bay of Fundy) during the spring (Dunton et al. 2010, Erickson et al. 2011, Wippelhauser et al. 2017). In areas with gravel, sand and/or silt bottom habitats and relatively shallow depths (primarily <50 meters), sturgeon may also be foraging during these trips on prey including mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Stein et al. 2004b, Dadswell 2006, Dunton et al. 2010, Erickson et al. 2011).

Atlantic sturgeon aggregate in several distinct areas along the Mid-Atlantic coastline; Atlantic sturgeon are most likely to occur in areas adjacent to estuaries and/or coastal features formed by bay mouths and inlets (Stein et al. 2004a; Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). These aggregation areas are located within the coastal waters off North Carolina; waters between the Chesapeake Bay and Delaware Bay; the southern New Jersey coast near the mouth of Delaware Bay; and the southwest shores of Long Island (Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). With the exception of the area off Long Island (which is outside the action area), these waters are in the action area but are further inshore than the routes that will be transited by project vessels moving between U.S. ports and the WDA. These aggregation areas are believed to be where Atlantic sturgeon overwinter and/or forage (Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). Based on five fishery-independent surveys, Dunton et al. (2010) identified several “hotspots” for Atlantic sturgeon captures, all located in depths of less than 20 m adjacent to estuaries including the Hudson River/NY Bight, Delaware Bay, Chesapeake Bay, Cape Hatteras, and Kennebec River. These “hotspots” are aggregation areas that are most often used during the spring, summer, and fall months (Erickson et al. 2011; Dunton et al. 2010). Areas between these sites are used by sturgeon migrating to and from these areas, as well as to spawning grounds found within natal rivers. Adult sturgeon return to their natal river to spawn in the spring. The nearest river to the lease area and the cable corridors that is known to regularly support Atlantic sturgeon spawning is the Delaware River.

Information from studies outside the action area helps inform consideration of the distribution of Atlantic sturgeon in the WDA. Dunton et al. (2015) caught sturgeon as bycatch in waters less than 50 feet deep during the New York summer flounder fishery, and Atlantic sturgeon occurred along eastern Long Island in all seasons except for the winter, with the highest frequency in the spring and fall. The species migrates along coastal New York from April to June and from October to November (Dunton et al. 2015). Ingram et al. (2019) studied Atlantic sturgeon distribution using acoustic tags and determined peak seasonal occurrence in the offshore waters of the OCS from November through January, whereas tagged individuals were uncommon or absent from July to September. The authors reported that the transition from coastal to offshore areas, predictably associated with photoperiod and river temperature, typically occurred in the autumn and winter months.

Migratory adults and sub-adults have been collected in shallow nearshore areas of the continental shelf (32.9–164 feet [10–50 m]) on any variety of bottom types (silt, sand, gravel, or clay). Evidence suggests that Atlantic sturgeon orient to specific coastal features that provide foraging opportunities linked to depth-specific concentrations of fauna. Concentration areas of Atlantic sturgeon near Chesapeake Bay and North Carolina were strongly correlated with the coastal features formed by the bay mouth, inlets, and the physical and biological features produced by outflow plumes (Kingsford and Suthers 1994, as cited in Stein et al. 2004a). They are also known to commonly aggregate in areas that presumably provide optimal foraging opportunities, such as the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, and Delaware Bay (Dovel and Berggren 1983; Johnson et al. 1997; Rochard et al. 1997; Kynard et al. 2000; Eyler et al. 2004; Stein et al. 2004a; Dadswell 2006, as cited in ASSRT 2007).

Stein et al. (2004a, 2004b) reviewed 21 years of sturgeon bycatch records in the Mid-Atlantic OCS to identify regional patterns of habitat use and association with specific habitat types.

Atlantic sturgeon were routinely captured in waters within and in immediate proximity to the action area, most commonly in waters ranging from 33 to 164 feet (10–50 m) deep. Sturgeon in this area were most frequently associated with coarse gravel substrates within a narrow depth range, presumably associated with depth-specific concentrations of preferred prey fauna.

Ingram et al. (2019) studied Atlantic sturgeon distribution in the New York Wind Energy Area by monitoring the movements of tagged Atlantic sturgeon from November 2016 through February 2018 on an array of 24 acoustic receivers (see Figure 1 in Ingram et al. 2019 for acoustic receiver locations). While this area is north of the action area, it is reasonable to expect that distribution and use of the Atlantic Shores WDA would be similar, given the similar geography and habitat conditions. Total confirmed detections for Atlantic Sturgeon ranged from 1 to 310 detections per individual, with a total of 5,490 valid detections of 181 unique individuals. Detections of 181 unique Atlantic sturgeon were documented with detections being highly seasonal peaking from November through January, with tagged individuals uncommon (less than 2 individuals detected) or absent in July, August, and September. As described in the paper, Atlantic Sturgeon were detected on all transceivers in the array including the most offshore receiver, located 44.3 km offshore (21 total detections of 5 unique fish). Total counts and detections of unique fish were highest at the receivers nearer to shore and appeared to decrease with distance from shore. Counts at each station ranged between 21–909 total detections and 4–59 unique detections of Atlantic sturgeon. Fifty-five individuals were documented in multiple years. The authors reported that the transition from coastal to offshore areas, predictably associated with photoperiod and river temperature, typically occurred in the autumn and winter months. During this time, individual Atlantic sturgeon were actively moving throughout the area. Residence events, defined in the paper as "a minimum of two successive detections of an individual at a single transceiver station over a minimum period of two hours. Residence events are completed by either a detection of the individual on another transceiver station or a period of 12 hours without detection." Residence events were uncommon (only 22 events over the study period) and of short duration (mean of 10 hours) and were generally limited to receivers with depths of less than 30 m. The authors indicate that the movement patterns may be suggestive of foraging but could not draw any conclusions. By assuming the maximum observed rate of movement of 0.86 m/s and maximum straight-line distance of 40.6 km between stations from the transceiver-distance matrix, the minimum transit time for an Atlantic Sturgeon through the NY WEA at its longest point was estimated to be 13.1 hrs. As described by the authors, the absence of Atlantic Sturgeon in the NY WEA during the summer months, particularly from June through September, suggests a putative shift to nearshore habitat and corresponds with periods of known-residence in shallow, coastal waters that are associated with juvenile and sub-adult aggregations as well as adult spawning migrations.

Surveys specifically targeting Atlantic sturgeon have not been carried out in the WDA; however, a number of surveys occur regularly in the action area, including the WDA, that are designed to characterize the fish community and use sampling gear that is expected to collect Atlantic sturgeon if they were present in the area. One such survey is the Northeast Area Monitoring and Assessment Program (NEAMAP), which samples from Cape Cod, MA south to Cape Hatteras, NC and targets both juvenile and adult fishes; NEAMAP samples near shore water to a depth of 60 feet and includes the sounds to 120 feet. Atlantic sturgeon are regularly captured in this survey; however, there are few instances of collection in the WDA. The area is also sampled in the NEFSC bottom trawl surveys, which surveys from Cape Hatteras to the Western Scotian

Shelf; few Atlantic sturgeon are collected in the WDA.

None of the scientific literature that has examined the distribution of Atlantic sturgeon in the marine environment has identified the lease area or cable corridor as a “hot spot” or an identified aggregation area (see above). However, given the depths (less than 50m) and the predominantly sandy substrate which are consistent habitat parameters with offshore areas where Atlantic sturgeon are known to occur, and the occasional collection of Atlantic sturgeon in this area in regional surveys and in commercial fisheries, at least some Atlantic sturgeon are likely to be present in the project area. Presence has been confirmed by the collection of Atlantic sturgeon in several sampling programs off the New Jersey coast (Stein et al. 2004b; Eyler et al. 2009; Dunton et al. 2010; Erickson et al. 2011). Dunton et al. (2010) analyzed data from surveys covering the northwest Atlantic Ocean from Cape Hatteras to the Gulf of Maine conducted by five agencies. The catch per unit of effort for Atlantic sturgeon off New Jersey, from New York Harbor south to the entrance of Delaware Bay (Delaware), was second only to catch per unit of effort from the entrance of New York Harbor to Montauk Point, New York. About 95% of all Atlantic sturgeon captured in the sampling off New Jersey occurred in depths less than 66 feet (20 meters) with the highest catch per unit of effort at depths of 33 to 49 feet (10 to 15 meters) (Dunton et al. 2010). Spawning, juvenile growth and development, and overwintering are not known to occur in the WDA. In the portion of the action area including the lease area and along the cable corridors, the majority of individuals will be from the New York Bight DPSs. Along vessel transit routes to and from ports in the South Atlantic, the majority of individuals will be from the South Atlantic DPS (Kazyak et al. 2021). Considering the action area as whole, individuals from all five DPSs may be present.

In summary, Atlantic sturgeon occur in most of the action area; with the exception being the Gulf of Mexico and waters transited by project vessels with depths greater than 50m. This means that in addition to the WDA and riverine/estuarine portions of the action area that will be transited by project vessels identified above, Atlantic sturgeon will only be present in the nearshore (less than 50 m depth) portion of the vessel transit routes and will not be present in the open ocean areas transited by vessels moving between the WDA and identified ports.

Critical Habitat for the New York Bight DPS of Atlantic sturgeon

Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. Critical habitat designated in the Delaware River for the New York Bight DPS of Atlantic sturgeon is the only critical habitat in the action area that may be affected by the proposed action. As described in section 5, the Delaware River portion of the action area overlaps with the Delaware River critical habitat unit and PBFs 2, 3, and 4 are present in the action area.

Activities that have and may continue to impact PBF 2 include those that may alter salinity and those that result in the loss or disturbance of soft sediment within the transitional salinity zone. These include activities that result in sediment disturbance and subsequent sediment deposition that buries prey species (where that deposited sediment is not immediately swept away with the current), direct removal or displacement of soft bottom substrate (e.g., dredging, construction), activities that result in the contamination or degradation of habitat reducing or eliminating populations of benthic invertebrates, and activities that influence the salinity gradient (e.g., climate change, deepening of the river channel, and flow management).

Actions that may affect PBF 3 include activities that present physical barriers that may impede sturgeon passage. While there are structures that sturgeon maneuver around within the Delaware River portion of the action area, there are no permanent barriers to movement (e.g., dams) in this area.

Actions that may affect PBF 4 include activities that affect temperature, salinity, and/or dissolved oxygen (DO). Water quality factors such as temperature, salinity, and DO are interrelated environmental variables, and in the Delaware River are constantly changing from influences of the tide, weather, season, etc. A number of human activities directly affect the temperature, salinity, and oxygen values within the Delaware River. Overall, water quality in the Delaware River has improved dramatically since the mid-20th century; however there are times and locations when temperature, salinity, and/or DO may not meet all requirements identified in PBF 4.

More information on the status of Atlantic sturgeon critical habitat in the Delaware River is contained in section 6.2.3 of the 2022 NJWP Biological Opinion and is incorporated here by reference; the information presented above is a summary of that information.

Shortnose sturgeon
The only portion of the action area that overlaps with the distribution of shortnose sturgeon is the Delaware River where vessels transiting to/from the Paulsboro Marine Terminal, Repauno Terminal, and New Jersey Wind Port will travel. The February 25, 2022 NJWP Biological Opinion discusses the status of shortnose sturgeon including the threats/stressors that affect this population in the Delaware River in Section 6. That information is incorporated here by reference and briefly summarized here. Shortnose sturgeon occur in the Delaware River from the lower bay upstream to at least Lambertville, New Jersey (RKM 238). The portion of the Delaware River that overlaps with the action area is downstream of the area where spawning and rearing of early life stages occurs; young-of-the-year, juveniles, and adults are expected to be present in the Delaware River portion of the action area. The Delaware River population of shortnose sturgeon is the second largest in the United States. Historical estimates of the size of the population are not available as historic records of sturgeon in the river did not discriminate between Atlantic and shortnose sturgeon. The most recent population estimate for the Delaware River is 12,047 (95% CI= 10,757-13,580) and is based on mark recapture data collected from January 1999 through March 2003 (ERC 2006a). Comparisons between the population estimate by ERC Inc. and the earlier estimate by Hastings et al. (1987) of 12,796 (95% CI=10,228-16,367) suggests that the population is stable, but not increasing.

Shortnose sturgeon in the Delaware River are affected by a number of threats including impingement at water intakes, habitat alteration and water quality, dredging, bycatch in commercial and recreational fisheries, water quality, in-water construction activities, and vessel traffic.

6.4 Consideration of Federal, State, and Private Activities in the Action Area

Activities in the Coastal and Riverine Portions of the Action Area
Project vessels are expected to transit portions of Delaware Bay and a portion of the Delaware River (to/from Paulsboro, the New Jersey Wind Port, and Repauno) and the Chesapeake Bay

entrance channels and lower Chesapeake Bay (to/from Portsmouth, VA). In addition to fishing activity and vessel traffic, portions of these areas have navigation channels that are maintained by dredging, and are affected by routine in-water construction activities such as dock, pier, and wharf maintenance and construction.

Loggerhead, Kemp's ridley, and green sea turtles and Atlantic and shortnose sturgeon are vulnerable to serious injury and mortality in hopper dredges that are used to maintain federal navigation channels in the action area, including channels in the Chesapeake Bay and Delaware Bay. NMFS has completed ESA Section 7 consultations on these actions; measures are in place to avoid and minimize take and in all cases, NMFS has determined that the proposed actions are not likely to jeopardize the continued existence of any listed species. We expect that mortality of sturgeon and sea turtles as a result of maintenance dredging and channel deepening will continue in the action area over the life of the Atlantic Shores South project.

As noted in section 3, NMFS has completed ESA section 7 consultation with the USACE on the effects of 10-years of maintenance dredging in 13 waterways within Atlantic City's waterways pursuant to USACE permit NAP-2021-00573-95. Work will be carried out under this permit as part of the Connected Action to construct an O&M Facility in Atlantic City. On January 27, 2022, NMFS concurred with USACE's determination that the proposed dredging was not likely to adversely affect any ESA listed species that may occur in the action area. This consultation was completed under the terms of NMFS GARFO's 2017 informal programmatic consultation with USACE's North Atlantic Division[29].

NMFS has completed ESA Section 7 consultations on the construction and use of three of the ports that may be used by Atlantic Shores South vessels; effects of these actions on shortnose and Atlantic sturgeon are addressed below.

Fishing Activity in the Action Area

Commercial and recreational fishing occurs throughout the action area. The lease area and cable corridor occupies a portion of NMFS statistical area 614 and a very small portion of 615. Transit routes to southern ports, including those in the Gulf of Mexico overlap with a number of other statistical areas (see, https://www.fisheries.noaa.gov/resource/map/greater-atlantic-region-statistical-areas).

Commercial fishing in the action area is authorized by the individual states or by NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Fisheries that operate pursuant to the MSFCMA have undergone consultation pursuant to Section 7 of the ESA. These biological opinions are available online (available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-biological-opinions-greater-atlantic-region). The accompanying Incidental Take Statements, which describe the amount or extent of incidental take anticipated to occur in these fisheries, are included with each opinion.

[29] More information on this programmatic consultation is available online at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic

Given that fisheries occurring in the action area are known to interact with large whales, the past and ongoing risk of capture and entanglement in the action area is considered here. The degree of risk in the future may change in association with fishing practices and accompanying regulations. It is important to note that in nearly all cases, the location where a whale first encountered entangling gear is unknown and the location reported is the location where the entangled whale was first sighted. The risk of entanglement in fishing gear to fin, sei, and sperm whales in the lease area appears to be low given the low interaction rates in the U.S. EEZ as a whole.

We have reviewed the most recent data available on reported entanglements for the ESA listed whale stocks that occur in the action area (Hayes et al. 2020, Hayes et al. 2022, Henry et al. 2022, Hayes et al. 2023). As reported in Hayes et al. 2022, for the most recent 5-year period of review (2015-2019) in the U.S. Atlantic, the minimum rate of serious injury or mortality resulting from fishery interactions was 1.45/year for fin whales, 0.4 for sei whales. For the period 2016-2020, the annual detected (observed) human-caused mortality and serious injury for right whales averaged 5.7 entanglements per year (Hayes et al. 2023). The minimum rate of serious injury or mortality resulting from fishery interaction is zero for sperm whales as reported in the most recent SAR for sperm whales in the North Atlantic (Hayes et al. 2020). For the Gulf of Mexico, Hayes et al. (2021) reports the estimated mean annual fishery-related mortality and serious injury for sperm whales during 2014–2018 was 0.2 sperm whales (CV=1.00) due to interactions with the large pelagic longline fishery. In all cases, the authors note that this is a minimum estimate of the amount of entanglement and resultant serious injury or mortality. These data represent only known mortalities and serious injuries; more, undocumented mortalities and serious injuries have likely occurred and gone undetected due to the offshore habitats where large whales occur. Hayes et al. (2020) notes that no confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database and that a review of the records of stranded, floating, or injured sei whales for the period 2015 through 2019 on file at NMFS found 3 records with substantial evidence of fishery interaction causing serious injury or mortality. Hayes et al. (2020), reports that sperm whales have not been documented as bycatch in the observed U.S. Atlantic commercial fisheries. No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database and a review of the records of stranded, floating, or injured fin whales for the period 2015 through 2019 with substantial evidence of fishery interactions causing injury or mortality are captured in the total observed incidental fishery interaction rate reported above (Hayes et al. 2022).

We also reviewed available data that post-dates the information presented in the most recent stock assessment reports. As explained in the Status of the Species section of this Opinion, there is an active UME for North Atlantic right whales[30]. Of the 121 right whales in the UME, 9 mortalities are attributed to entanglement as well as 31 serious injuries and 39 sublethal injuries. None of the whales recorded as part of the UME were first documented in the lease area or along the cable routes[31]. We reviewed information on serious injury and mortalities reported in Henry

[30] Information in this paragraph related to the UME is available at: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event; last accessed on November 28, 2023

[31] https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=e502f7daf4af43ffa9776c17c2aff3ea; last accessed October 30, 2023

et al. 2022. Two live right whales were first documented as entangled in waters off the coast of New Jersey; right whale 3405 was documented as entangled in netting on December 4, 2016 approximately 3.5 nm east of Sandy Hook, right whale 4680 was documented as entangled in unknown gear on October 11, 2020 approximately 2.7 nm east of Sea Bright, NJ. It is unknown where either of these entanglements actually occurred. Henry et al. 2022 includes no records of entangled fin, sei, or sperm whales first reported in waters off New Jersey.

Given the co-occurrence of fisheries and large whales in the action area, it is reasonable to expect that there have been entanglements in the action area in the past and that this risk will persist at some level throughout the life of the project. However, it is important to note that several significant actions have been taken to reduce the risk of entanglement in fisheries that operate in the action area including ongoing implementation of the Atlantic Large Whale Take Reduction Plan. The goal of the ALWTRP is to reduce injuries and deaths of large whales due to incidental entanglement in fishing gear. The ALWTRP is an evolving plan that changes as NMFS learns more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. It has several components including restrictions on where and how gear can be set; research into whale populations and whale behavior, as well as fishing gear interactions and modifications; outreach to inform and collaborate with fishermen and other stakeholders; and a large whale disentanglement program that seeks to safely remove entangling gear from large whales whenever possible. All states that regulate fisheries in the U.S. portion of the action area codify the ALWTRP measures into their state fishery regulations.

Atlantic sturgeon are captured as bycatch in trawl and gillnet fisheries. An analysis of the NEFOP/ASM bycatch data from 2000-2015 (ASMFC 2017) found that most trips that encountered Atlantic sturgeon were in depths less than 20 meters and water temperatures between 45-60°F. Average mortality in bottom otter trawls was 4% and mortality averaged 30% in gillnets (ASMFC 2017). The most recent five years of data in the NMFS NEFOP and ASM database were queried for the number of reports of Atlantic sturgeon bycatch in the statistical area that overlaps with the lease area and cable routes (614[32]). The NEFOP program samples a percentage of trips from the Gulf of Maine to Cape Hatteras while the ASM program provides additive coverage for the New England ground fish fisheries, extending from Maine to New York. For the most recent five-year period that data are available (2016-2020), a total of 77 Atlantic sturgeon were reported as bycatch in statistical area 614, this represents approximately 5% of the total bycatch of Atlantic sturgeon in the Maine to Cape Hatteras area where the NEFOP, and Maine to New York area where the ASM program, operates. Incidental capture of Atlantic sturgeon is expected to continue in the action area at a similar rate over the life of the proposed action. While the rate of encounter is low and survival is relatively high (96% in otter trawls and 70% in gillnets; ASMFC 2017), bycatch is expected to be the primary source of mortality of Atlantic sturgeon in the Atlantic Ocean portion of the action area. Atlantic sturgeon do not occur in the Gulf of Mexico.

Sea turtles are vulnerable to capture in trawls as well as entanglement in gillnets and vertical lines. Using the same data source as for Atlantic sturgeon, from 2012-2020 there were a total of 4 incidents of observed sea turtle bycatch in fisheries in area 614 (3 loggerheads, 1 Kemp's

[32] Map available at:
https://www.greateratlantic.fisheries.noaa.gov/educational_resources/gis/gallery/gafostatisticalareas.html

ridley); the most recent record was from 2017 and all four turtles were captured in otter trawls. Leatherback sea turtles are particularly vulnerable to entanglement in vertical lines. Since 2005, 379 leatherbacks have been reported entangled in vertical lines in the Northeast Region. In response to high numbers of leatherback sea turtles found entangled in the vertical lines of fixed gear in the Northeast Region, NMFS established the Northeast Atlantic Coast Sea Turtle Disentanglement Network (STDN). Formally established in 2002, the STDN is an important component of the National Sea Turtle Stranding and Salvage Network. The STDN works to reduce serious injuries and mortalities caused by entanglements and is active throughout the action area responding to reports of entanglements. The Southeast STDN provides similar services in the South Atlantic and Gulf of Mexico. Where possible, turtles are disentangled and may be brought back to rehabilitation facilities for treatment and recovery. Sea turtles are also captured in fisheries operating in the Gulf of Mexico and in offshore areas where pelagic fisheries such as the Atlantic Highly Migratory Species (HMS) fishery occurs. Sea turtles are also vulnerable to interactions with fisheries occurring off the U.S. South Atlantic coast including the Atlantic shrimp trawl fishery. For all fisheries for which there is a fishery management plan (FMP) or for which any federal action is taken to manage that fishery, the impacts have been evaluated via Section 7 consultation. Past consultations have addressed the effects of federally permitted fisheries on ESA listed species, sought to minimize the adverse impacts of the action on ESA listed species, and, when appropriate, have authorized the incidental taking of these species. Incidental capture and entanglement of sea turtles is expected to continue in the action area at a similar rate over the life of the proposed action. Safe release and disentanglement protocols help to reduce the severity of impacts of these interactions and these efforts are expected to continue over the life of the project.

Vessel Operations

The action area is used by a variety of vessels ranging from small recreational fishing vessels to large commercial cargo ships. Commercial vessel traffic in the action area includes research, tug/barge, liquid tankers, cargo, military and search-and-rescue vessels, and commercial fishing vessels.

Vessel Traffic between the Lease Area and Ports to the South

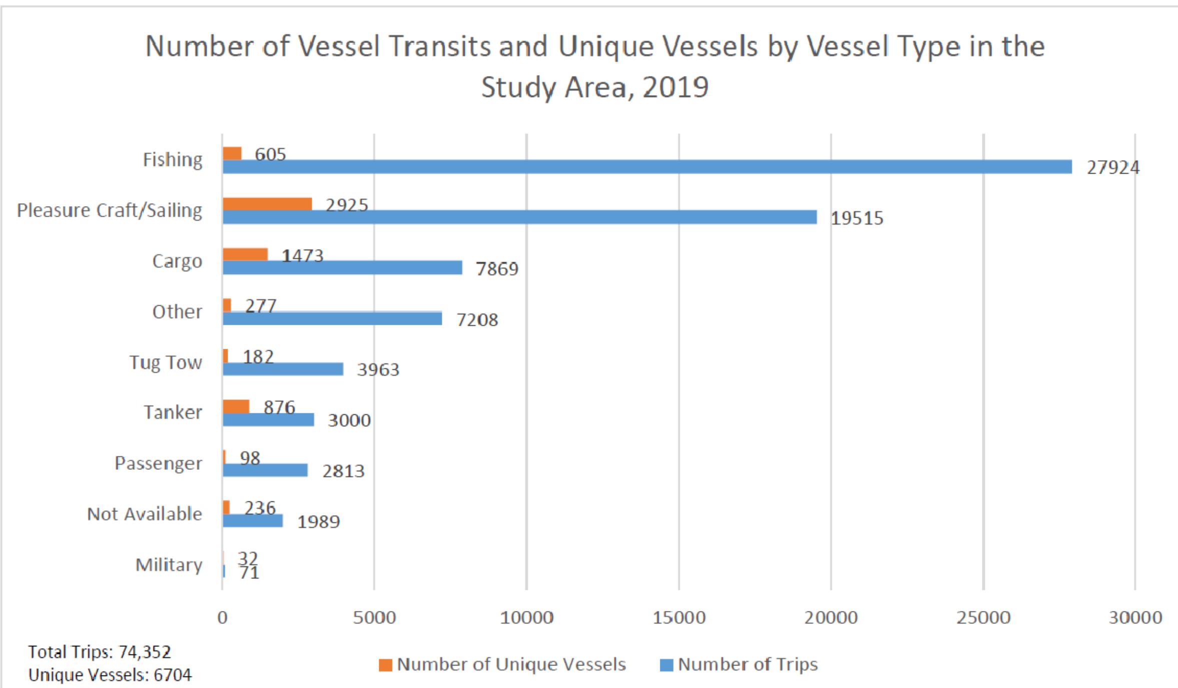
Vessel traffic along the southern U.S. coast mainly consists of tug and barge, fishing vessels, tankers, container ships, and passenger vessels; military vessels also transit the area conducting training and operations. Vessels typically travel offshore before entering a traffic separation scheme heading into port. Traffic generally travels in a north to south or south to north direction. Throughout the Mid-Atlantic, commercial vessel traffic is significant throughout the year with a number of major U.S. ports located along the coast. These ports include ones in the Chesapeake Bay/Norfolk, VA, and the Delaware Bay. Vessel traffic is heaviest in the nearshore waters, near major ports, in the shipping lanes. Recreational vessel traffic is high throughout these areas but is generally close to shore compared to commercial vessel travel.

The Gulf of Mexico is known for a high level of commercial shipping activity and many large ports, especially those with transiting bulk carriers (Wiggins et al. 2016). AIS data for the Gulf of Mexico shows a variety of vessel traffic for the region ranging from cargo, fishing, passenger, pleasure, tankers, and tug-tows. Ports located within the Gulf of Mexico support large amounts of shipping traffic (e.g., the ports of Houston, TX and Corpus Christi, TX have annual tonnage of

240,933,408 and 85,674,968 respectively).[33] Gulf of Mexico vessel traffic is routed with shipping fairways, traffic separations schemes, and traffic lanes.

Vessel Traffic in the Lease Area and Surrounding Waters
Information from a number of sources including the DEIS and the Navigational Safety Risk Assessment (NSRA) prepared to support the COP (COP Appendix II-S), and the USCG's Final Port Access Route Study for the Seacoast of New Jersey (NJPARS, USCG 2021) helps to establish the baseline vessel traffic in the WDA (i.e., the portion of the lease area where WTGs will be placed and the two cable corridors) and surrounding area. USCG's NJPARS analyzed Automatic Identification System (AIS) data in the five BOEM OCS lease areas and the Hudson South Wind Planning Area along the seacoast of New Jersey including offshore approaches to the Delaware Bay and found 74,352 annual transits through the study area by 6,704 unique vessels in 2019 (Figure 6 in the 2020 NJPARS Vessel Traffic Analysis). The study concluded that vessel activity in the study area was largely commercial fishing. Commercial fishing fleets that currently transit the Lease Area primarily originate from Atlantic City, Sea Isle City, Wildwood, Lower Township, and Cape May.

Figure 6.1. Number of Vessel Transits and Unique Vessels by Vessel Type in the NJPARS Study Area, 2019



Source: Figure 6, 2020 Vessel Traffic Analysis for Port Access Route Study: Seacoast of New Jersey including the offshore approaches to the Delaware Bay, Delaware (NJ PARS)

Section 3 of the NSRA characterizes the baseline vessel traffic within a Marine Traffic Study Area, which is inclusive of the WDA, the remainder of the Lease Area, and offshore waters for more than 40 nm in any direction. The study describes baseline conditions according to

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[33] marinecadastre.gov (last accessed October 17, 2023).

identified vessel types, their characteristics, operating areas/routes, separation zones, traffic density, and seasonal traffic variability using AIS data for one year (March 1, 2019 – February 29, 2020), stakeholder outreach, 2014 – 2019 VMS data, Vessel Trip Report data, the draft NJPARS, and marine transportation/traffic Nationwide AIS data.

AIS data show that 4,543 transits per year enter the WDA in total, including some minor double-counting (Appendix II-S BOEM, 2023). The NSRA analyzed vessel traffic activity within the study area as transit counts per transect with transect locations selected to evaluate the areas of heaviest vessel traffic in the vicinity of the Lease Area. The study concluded that there were no high-density traffic areas within several miles of the WDA (Figure 6.2). Only three transects have more than 10 transits per day, according to the AIS data (3,650 transits per year):

- The entrance to Delaware Bay with an average of about 18 transits per day,
- Barnegat Inlet with an average of 16 transits per day, and,
- The eastern end of Delaware Bay with an average of 11 transits per day.

The NSRA included a comprehensive vessel traffic survey in the study area using automatic identification system (AIS) data from 2017 through 2019. AIS is required only for vessels 65' or larger and is optional for smaller vessels. The data include eight vessel classes: dry cargo, fishing, other, passenger, recreational, tanker, military, and tug-barge (Baird 2022). Dry cargo and fishing vessels are the most frequent vessels that transit through the WDA. Overall, fishing vessels (transiting and fishing) represented 41% of total vessel traffic based on unique transits through the WDA and recreational vessels account for 14% of unique transits. The coastal traffic west of the Lease Area is predominantly tug transits, while the coastal traffic farther south is predominantly pleasure and fishing vessels. Some deep-draft vessel traffic (cruise ships, cargo and carrier ships, and tankers) occurs within the Lease Area but most of the deep-draft vessels in the vicinity of the Lease Area pass to the east. It should be noted that there are carriage requirements associated with AIS (self-propelled vessels of more than 1,600 gross tons with certain exceptions made for foreign vessels), thus certain vessel classes may be underestimated (i.e. fishing vessels, recreational vessels). The WDA receives increased vessel traffic in late spring and remains higher through early fall. Commercial fishing vessels that were equipped with AIS transited the WDA, primarily traveling in the north-northeast/south-southwest and northwest/southeast directions; some vessels also actively fish in the Lease Area.

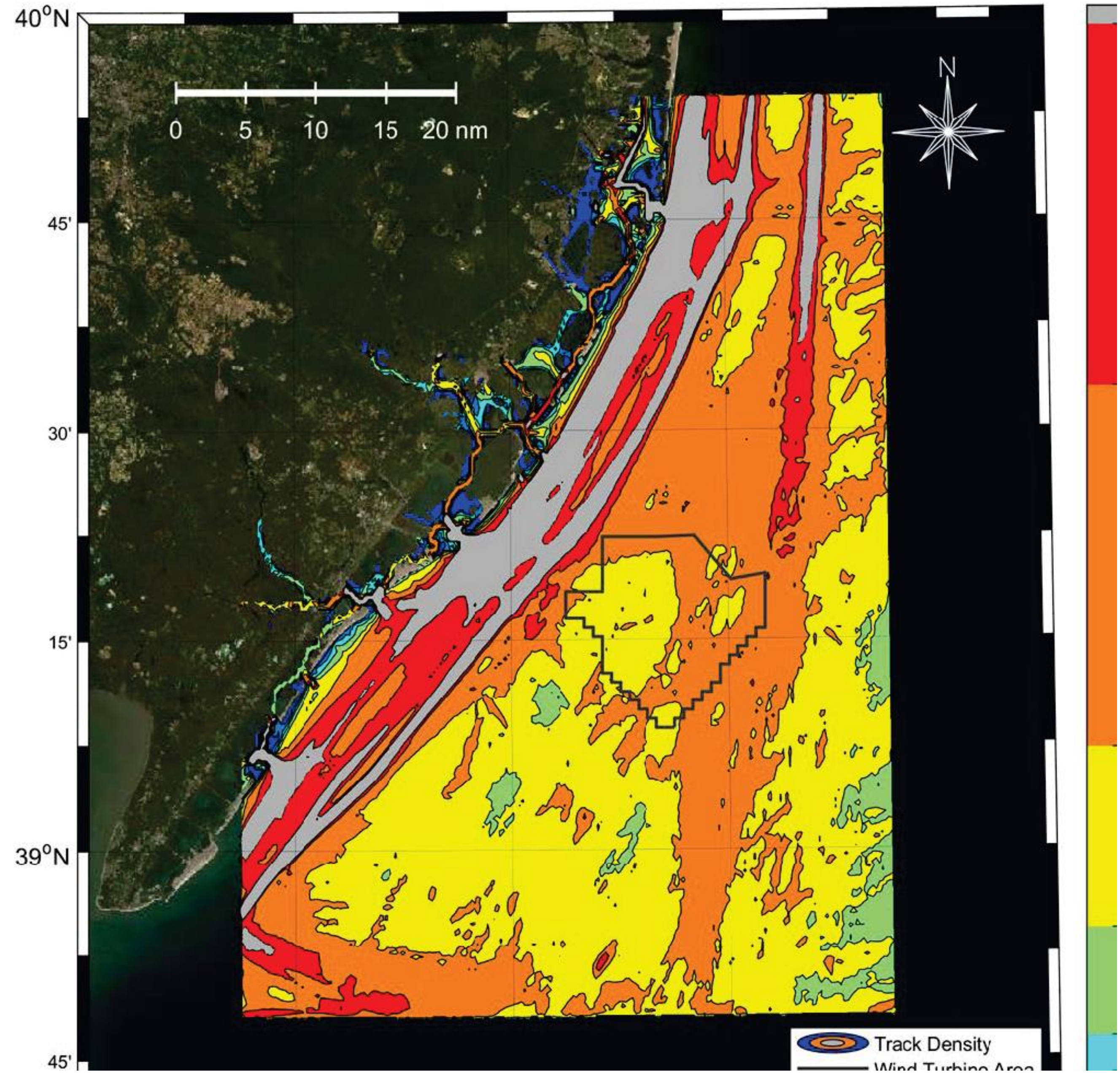
The major commercial fishing ports closest to the WDA are Atlantic City, Sea Isle City, Wildwood, and Cape May. There are no significant commercial fishing fleets in Delaware that operate near the WFA. Fishing vessels have a wide range of tracks through the WDA with the most frequent transit directions along southwest to northeast tracks (and vice versa), northwest to southeast (and vice versa), and north to south tracks (and vice versa). AIS-equipped fishing vessels are typically 70 to 100 ft. LOA, and there are a number of fishing vessels less than 65 ft. LOA which transit through the WDA but are not transmitting AIS data. The frequency and density of fishing activities within the WDA is variable between months and years. Fishing activity is usually highest between the months of July and September. The number of fishing tracks is low compared to fishing vessel transits through the WDA.

AIS data suggests that despite there being countless recreational vessels located along the New

Jersey Atlantic shore at marinas scattered along numerous inlets with ocean access, the majority of these recreational vessels operate west of the Lease Area with comparatively few tracks in the WDA. Recreational vessels transit the WDA on a regular basis with an average of 333 unique transits per year through the WDA over the three-year data period. Most recreational vessels have a LOA of 30 to 60 ft. (15 to 20 m). Recreational vessels cruising along the East Coast generally fall into two categories, dependent on their size and seakeeping ability. Smaller coastal cruisers, sail and especially motor, will cruise along the shore, usually within a few miles from the coast, taking advantage of the ability to visually navigate and often day cruising from port to port. These vessels will transit well inshore of any above water obstructions of the WDA. Vessels of greater seakeeping ability and underway on long distance transits may spend two or more days at sea between port calls. When traveling north-south along the East Coast of the United States, these vessels may travel a direct route, often further offshore, which could bring them near above water obstructions in the WDA.

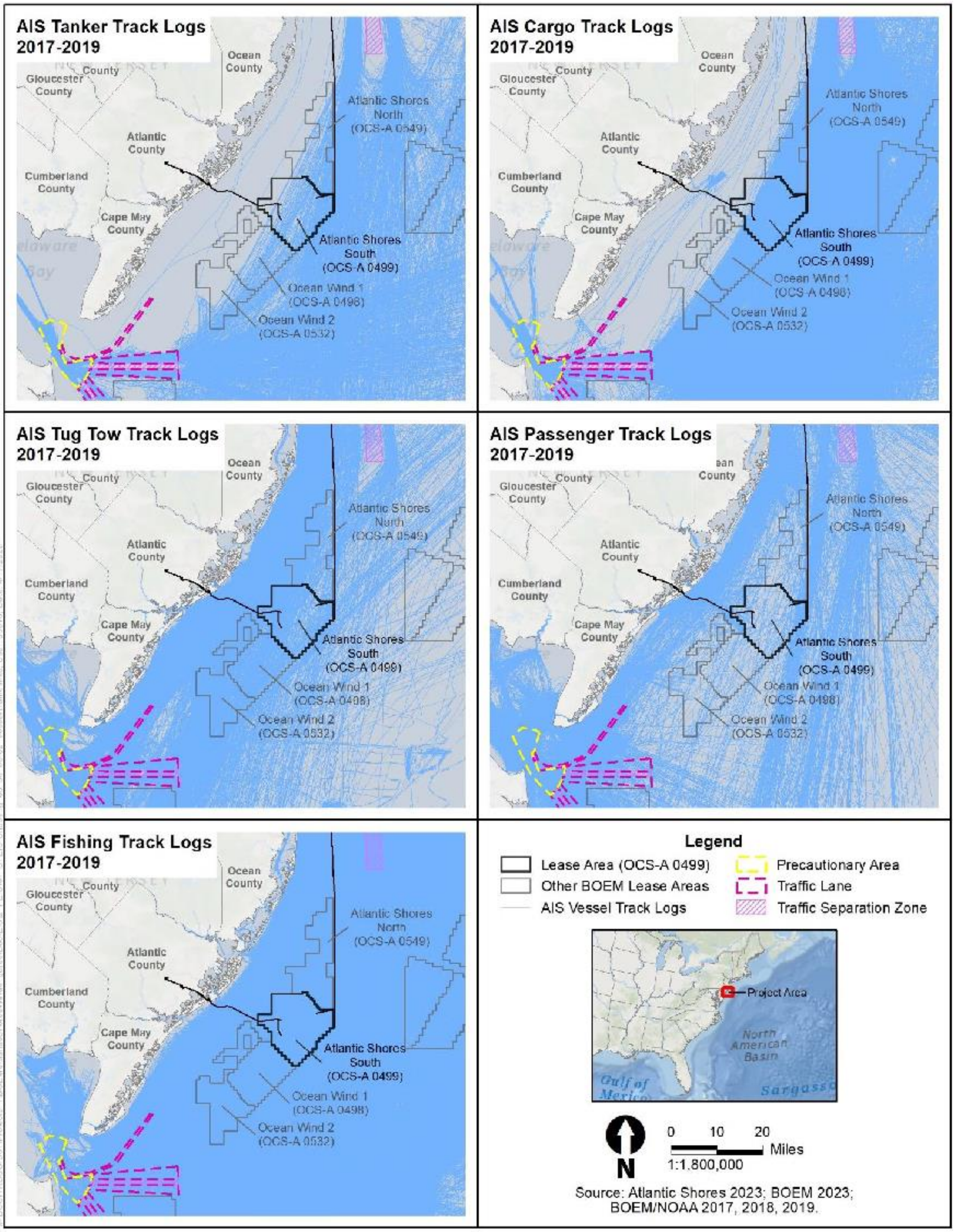
Large and medium sized passenger vessels (e.g., cruise ships, large ferries) generally transit well east of the WFA en route to and from the Ambrose/Barnegat Traffic lanes to the north. These vessels often were traveling between the Port of New York/New Jersey and foreign ports in the Caribbean or Bermuda.

Figure 6.2. Lease Area Boundary Box



Source: 2020 Vessel Traffic Analysis for Port Access Route Study: Seacoast of New Jersey including the offshore approaches to the Delaware Bay, Delaware (NJ PARS)

Figure 6.3. Vessel Traffic in the Vicinity of the Lease Area. Source: Atlantic Shores Offshore Wind DEIS 2023



Note: AIS track counts for fishing and pleasure vessels underrepresent these vessel types, as not all of these vessel types are required to have AIS on board per USCG regulations.

The WDA is in relatively deep water 62 to 121 ft. (19 to 37 m), and there are no impediments to navigation through this area presently. There are no demarcated waterways adjacent to or within the WTA; however, there is the Ambrose-Barnegat Traffic Separation Scheme (TSS) leading to and from New York City. This TSS is located approximately 25 nm (46 km) north of the WDA. A TSS separates opposing streams of vessel traffic by creating separated, unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting to and from major ports. Since the WDA is so far south of the Ambrose-Barnegat TSS area, it is not expected to impede commercial traffic in or out of that TSS. Further to the north of the action area (approximately 46 miles [40 nm, 74 km]) is a TSS that regulates vessel traffic in the approach to New York Harbor (NOAA 2021b, p. 361). There is a speed-restricted area for NARW seasonal management area within the action area (50 CFR 224.105).

To comply with the Ship Strike Reduction Rule (50 CFR 224.105), all vessels greater than or equal to 65 ft. (19.8 m) in overall length and subject to the jurisdiction of the United States and all vessels greater than or equal to 65 ft. in overall length entering or departing a port or place subject to the jurisdiction of the United States must slow to speeds of 10 knots or less in seasonal management areas (SMA). Mid-Atlantic SMAs in the vicinity of the project area include the ports of New York/New Jersey and the entrance to the Delaware Bay. All vessels 65 feet or longer that transit the SMAs from November 1 – April 30 each year (the period when right whale abundance is greatest) must operate at 10 knots or less. Mandatory speed restrictions of 10 knots or less are required in all of the SMAs along the U.S. East Coast during times when right whales are likely to be present; a number of these SMAs overlap with the portion of the action area that may be used by project vessels. The purpose of this regulation is to reduce the likelihood of deaths and serious injuries to these endangered whales that result from collisions with ships. On August 1, 2022, NMFS published proposed amendments to the North Atlantic vessel strike reduction rule (87 FR 46921). The proposed rule would: (1) modify the spatial and temporal boundaries of current speed restriction areas referred to as Seasonal Management Areas (SMAs), (2) include most vessels greater than or equal to 35 ft. (10.7 m) and less than 65 ft. (19.8 m) in length in the size class subject to speed restriction, (3) create a Dynamic Speed Zone framework to implement mandatory speed restrictions when whales are known to be present outside active SMAs, and (4) update the speed rule's safety deviation provision. Changes to the speed regulations are proposed to reduce vessel strike risk based on a coast-wide collision mortality risk assessment and updated information on right whale distribution, vessel traffic patterns, and vessel strike mortality and serious injury events. To date, the rule has not been finalized and its potential effects have not been included in the baseline. Additional information on the risk of vessel strike to right whales is found in the materials prepared to support the proposed rule including Garrison et al. 2022 and the July 2022 Draft Environmental Assessment[34].

Restrictions are in place on how close vessels can approach right whales to reduce vessel-related impacts, including disturbance. NMFS rulemaking (62 FR 6729, February 13, 1997) restricts vessel approach to right whales to a distance of 500 yards. This rule is expected to reduce the potential for vessel collisions and other adverse vessel-related effects in the environmental baseline. The Mandatory Ship Reporting System (MSR) requires ships entering the northeast and southeast MSR boundaries to report the vessel identity, date, time, course, speed,

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[34] Available at: https://www.fisheries.noaa.gov/action/amendments-north-atlantic-right-whale-vessel-strike-reduction-rule

destination, and other relevant information. In return, the vessel receives an automated reply with the most recent right whale sightings or management areas and information on precautionary measures to take while in the vicinity of right whales.

SMAs are supplemented by Dynamic Management Areas (DMAs) that are implemented for 15-day periods in areas in which right whales are sighted outside of SMA boundaries (73 FR 60173; October 10, 2008). DMAs can be designated anywhere along the U.S. eastern seaboard, including the action area, when NOAA aerial surveys or other reliable sources report aggregations of three or more right whales in a density that indicates the whales are likely to persist in the area. DMAs are put in place for two weeks in an area that encompass an area commensurate to the number of whales present. Mariners are notified of DMAs via email, the internet, Broadcast Notice to Mariners (BNM), NOAA Weather Radio, and the Mandatory Ship Reporting system (MSR). NOAA requests that mariners navigate around these zones or transit through them at 10 knots or less. In 2021, NMFS supplemented the DMA program with a new Slow Zone program, which identifies areas for recommended 10-knot speed reductions based on acoustic detection of right whales. Together, these zones are established around areas where right whales have been recently seen or heard, and the program provides maps and coordinates to vessel operators indicating areas where they have been detected. Compliance with these zones is voluntary.

Atlantic sturgeon, sea turtles, and ESA listed whales are all vulnerable to vessel strike, although the risk factors and areas of concern are different. Vessels have the potential to affect animals through strikes, sound, and disturbance by their physical presence.

As reported in Hayes et al. 2022, for the most recent 5-year period of review (2015-2019) in the North Atlantic, the minimum rate of serious injury or mortality resulting from vessel interactions is 0.40/year for fin whales, 0.2 for sei whales. As reported in Hayes et al. 2023, for the most recent 5-year period of review (2016-2020) in the North Atlantic, the minimum rate of serious injury or mortality resulting from vessel interactions is 2.4/year for right whales. No vessel strikes for sperm whales have been documented (Hayes et al. 2020). Hayes et al. (2021) reports no vessel strikes have been documented in recent years (2014–2018) for sperm whales in the Gulf of Mexico. Historically, one possible sperm whale mortality due to a vessel strike was documented for the Gulf of Mexico. The incident occurred in 1990 near Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the vessel strike was probably pre-mortem (Jensen and Silber 2004). A review of available data on serious injury and mortality determinations for sei, fin, sperm, and right whales for 2000-2020 (Henry et al. 2022, UME website as cited above), includes one fin whale documented on the bow of a ship in Elberon, NJ (June 2020) and one sei whale documented on the bow of a ship in Newark, NJ (July 2016). While both individuals were reported as fresh dead, there is no indication of where the whales were actually hit. Hayes et al. (2021) reports three vessel struck sei whales first documented in the U.S. Northeast – all three were discovered on the bow of vessels entering port (two in the Hudson River and one in the Delaware River); no information on where the whales were hit is available. Hayes et al. (2020) reports only four recorded ship strikes of sperm whales. In May 1994, a ship-struck sperm whale was observed south of Nova Scotia (Reeves and Whitehead 1997), in May 2000, a merchant ship reported a strike in Block Canyon, and in 2001, and the U.S. Navy reported a ship strike within the EEZ (NMFS, unpublished data). In 2006, a sperm whale was found dead from ship-strike wounds off Portland, Maine. A similar rate of strike is expected to continue in the action area over the life of the project and we expect vessel strike will continue to be a source of mortality for right, sei, fin, and sperm whales in the action area. As outlined above, there are a number of measures that are in place to reduce the risk of vessel strikes to large whales that apply to vessels that operate in the action area.

NMFS' Sea Turtle Stranding and Salvage Network (STSSN) database provides information on records of stranded sea turtles in the region. The STSSN database was queried for records of stranded sea turtles with evidence of vessel strike throughout the waters of New Jersey to overlap with the area where the majority of project vessel traffic will occur. Out of the 747 recovered stranded sea turtles in New Jersey/Delaware waters from 2013 through 2022 (10 years), there were 210 definitely recorded sea turtle vessel strikes and 106 recorded blunt force traumas which are likely vessel strikes, primarily between the months of August and November. The majority of strikes and blunt force traumas were of loggerheads with a smaller number of leatherbacks, Kemp's ridleys, and green turtles. A similar rate of strike is expected to continue in the action area over the life of the project and that vessel strike will continue to be a source of mortality for sea turtles in the action area. Due to the greater abundance of sea turtles in southern portions of the action area, particularly along the Florida coast and in the Gulf of Mexico, vessel strike occurs more frequently in this portion of the action area. Foley et al. (2019) reports that based on stranding numbers, being struck by a vessel causes up to about 30% of the mortality of loggerheads, green turtles, and leatherbacks; and up to about 25% of the mortality of Kemp's ridleys in the nearshore areas of Florida. The authors estimate that overall, strikes by motorized watercraft killed a mean of 1,326–4,334 sea turtles each year in Florida during 2000–2014.

Atlantic sturgeon are struck and killed by vessels in at least some portions of their range. There are no records of vessel strike in the Atlantic Ocean, with all records within rivers and estuaries. Atlantic sturgeon are known to be struck and killed in portions of the action area that will be transited by project vessels including Delaware Bay and the Delaware River. Risk is thought to be highest in areas with geographies that increase the likelihood of co-occurrence between Atlantic sturgeon and vessels operating at a high rate of speed or with propellers large enough to entrain sturgeon. A summary of information on vessel strikes of Atlantic sturgeon in the Delaware River and Bay is provided in the *Status of the Species* section of this Opinion. In addition, the effects of transits anticipated and analyzed in the 2023 Paulsboro Biological Opinion, the 2022 New Jersey Wind Port Opinion, and the 2017 Repauno Opinion, influence the environmental baseline for this action.

In the December 8, 2017, Biological Opinion issued to USACE for the construction and operation of the Repauno Terminal, NMFS concluded that the construction and use of the Terminal was likely to adversely affect but not likely to jeopardize shortnose sturgeon or any DPS of Atlantic sturgeon. In the BA for the Atlantic Shores South project, BOEM estimates up to 20 trips to Repauno during construction, 1 during O&M, and up 20 during decommissioning for a total of up to 41 trips. This is approximately 1% of the total trips considered in the 2017 Repauno Opinion. In the 2017 Opinion, NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Repauno Terminal during 30 years of port operations will result in the mortality of 1 shortnose sturgeon and 6 Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 1 from the Chesapeake Bay DPS, 1 from the

Chesapeake Bay or Gulf of Maine DPS). The 2017 Opinion calculated this mortality based on an estimate of 133 trips per year for the 30-year life of the terminal (3,990 trips total). New information available since the 2017 Repauno Opinion has been used in other Opinions (including the Paulsboro and NJWP Opinions addressed above) to predict Atlantic sturgeon vessel strikes on a per vessel basis. Using a carcass reporting rate calculated by Fox et al. 2020, an actual mortality rate of 0.0091 sturgeon killed per vessel trip in the Delaware River has been calculated (see 2023 Paulsboro Opinion for complete description of the development of the mortality rate). In the context of the *Environmental Baseline* for another Biological Opinion (the November 2023 Paulsboro Opinion) NMFS applied new information on Atlantic sturgeon carcass recovery rates (Fox et al. 2020) to update the predictions of vessel strikes from all trips described in the 2017 Repauno Opinion to 43 strikes of Atlantic sturgeon over a 30 year period. Using the 0.0091 strikes/trip rate for the 41 Atlantic Shores trips to Repauno, we estimate up to 0.37 Atlantic sturgeon would be struck by Atlantic Shores' vessels transiting in the Delaware River to/from the Repauno Terminal. As such, we anticipate that vessels using the Repauno Port as part of the Atlantic Shores South project will result in the strike of no more than one Atlantic sturgeon. Considering the apportionment of strikes by DPS outlined in the consideration of Repauno in the Environmental Baseline of the 2023 Paulsboro Opinion, we expect that this individual would originate from the New York Bight DPS. There is no new information that suggests that estimates of shortnose sturgeon vessel strike in the Delaware River require updating from the predictions made in the 2017 Repauno Opinion. As such and considering that based on the available information, Atlantic Shores South vessels are similar to the vessels considered in that Opinion and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 1% of the total vessel strikes of shortnose sturgeon anticipated to occur as a result of trips within the Delaware River for vessels traveling to/from Repauno could result from Atlantic Shores vessels. Calculating 1% of 1 shortnose sturgeon results in an estimate of 0.01 vessel struck sturgeon. Given that the estimate is approaching zero, we consider it extremely unlikely that an Atlantic Shores vessel transiting within the Delaware River/Bay to/from the Repauno facility will strike a shortnose sturgeon.

In the February 25, 2022, Biological Opinion issued to USACE for the construction of the NJWP, NMFS concluded that the construction and subsequent use of the New Jersey Wind Port was likely to adversely affect but not likely to jeopardize shortnose sturgeon or any DPS of Atlantic sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of 4 shortnose sturgeon and 35 Atlantic sturgeon (23 New York Bight DPS, 5 Chesapeake Bay DPS, 5 South Atlantic DPS, 2 Gulf of Maine DPS) as a result of vessel strike. The Opinion calculated these mortalities based on 1,280 vessel trips annually during the 25-year operational life of the port. In the BA for the Atlantic Shores South project, BOEM estimates up to 1,250 trips to the NJWP (Table 1-9 in the BA) during the construction phase and up to 32 trips during the O&M phase, and another 1,250 trips during decommissioning, for a total of 2,532 trips. This is approximately 8% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Atlantic Shores' vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 8% of the total vessel strikes of Atlantic sturgeon could result from Atlantic Shores South vessels. Calculating 8% of 35 Atlantic sturgeon results in an estimate of 2.8 vessel struck sturgeon. As such, we anticipate that vessels using the NJWP as part of the Atlantic Shores South project will result in the strike of no more than three Atlantic sturgeon. Considering the apportionment of take by DPS outlined in the February 2022 Opinion, we expect that two of these would be from the New York Bight DPS with one from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS. Calculating 8% of 4 shortnose sturgeon results in an estimate of 0.32 vessel struck sturgeon. As such, we expect that vessels using the NJWP as part of the Atlantic Shores project will result in the lethal strike of up to one shortnose sturgeon.

In the November 7, 2023, Biological Opinion issued to USACE for the construction and operation of the Paulsboro Marine Terminal (which replaced the July 2022 Opinion), NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize shortnose sturgeon or any DPS of Atlantic sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of one shortnose sturgeon and eight Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 2 from the Chesapeake Bay DPS, 1 from the South Atlantic DPS, and 1 from the Gulf of Maine DPS). The Opinion calculated this mortality based on a maximum of 880 vessel trips from 2023-2032. In the BA for the Atlantic Shores South project, BOEM estimates up to 122 trips to the Paulsboro Marine Terminal (Table 1-9 in the BA) during the construction and O&M phases. This is approximately 14% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, Atlantic Shores South vessels are similar to the vessels described in the Paulsboro Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 14% of the total vessel strikes of Atlantic sturgeon could result from Atlantic Shores South vessels. Calculating 14% of 8 Atlantic sturgeon results in an estimate of 1.12 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Atlantic Shores South project will result in the strike of no more than two Atlantic sturgeon. Based on the proportional assignment of take in the November 2023 Paulsboro Opinion, we expect that these are likely to be Atlantic sturgeon belonging to the New York Bight DPS. Calculating 14% of 1 shortnose sturgeon results in an estimate of 0.14 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Atlantic Shores South project will result in the strike of up to one shortnose sturgeon.

In the November 7, 2023, Biological Opinion NMFS concluded that the construction and subsequent use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and subsequent use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that the subsequent use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to affect critical habitat. Due to the nature of the effects to critical habitat described in the NJWP Opinion (i.e., intermittent scouring and disturbance of river sediments), we are not able to determine the proportional effects of Atlantic Shores South vessel use of these port facilities on critical habitat. However, based on the available information, including consideration of vessel type and number of trips, we determined the effects of the Atlantic Shores South vessels are within the scope of effects considered in the NJWP Opinion. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the *Environmental Baseline* for the Atlantic Shores South project.

Offshore Wind Development

The action area includes a number of areas that have been leased by BOEM for offshore wind development or that are being considered for lease issuance (see maps at https://www.boem.gov/renewable-energy/offshore-renewable-activities). As noted above, in the *Environmental Baseline* section of an Opinion, we consider the past and present impacts of all federal, state, or private activities and the anticipated impacts of all proposed federal actions that have already undergone Section 7 consultation. In the context of offshore wind development, past and present impacts in the action area include the effects of pre-construction surveys to support site characterization, site assessment, and data collection to support the development of Construction and Operations Plans (COPs) and the past construction and present operation of the two CVOW Demonstration Project wind turbine generators operating off the coast of Virginia.

To date, we have completed Section 7 consultation to consider the effects of construction, operation, and decommissioning of multiple commercial scale offshore wind projects along the U.S. Atlantic coast (Vineyard Wind 1, South Fork Wind, Ocean Wind 1, Empire Wind 1 and 2, Sunrise Wind, CVOW, Revolution Wind). To date, construction has only started for South Fork Wind and Vineyard Wind 1; these projects are outside of the Atlantic Shores action area. We have also completed ESA Section 7 consultation on two smaller scale offshore wind projects; the Block Island project (outside the action area), and Dominion's Coastal Virginia Offshore Wind Demonstration Project (within the action area); these projects are in the operations and maintenance phase. The Atlantic Shores action area (as defined in Section 3, inclusive of vessel transit routes), includes the Ocean Wind 1 and CVOW project areas. The Ocean Wind 1 lease area project is directly adjacent to the Atlantic Shores South lease area and construction had been anticipated to begin in 2024; however, the status of the Ocean Wind 1 project is currently unclear as the developer has indicated that they are not currently pursuing construction. Atlantic Shores' vessels transiting to/from Corpus Christi, TX and Portsmouth, VA are expected to transit past the CVOW project area. Given the vessel transit routes of a number of the other projects (e.g., the Revolution Wind project includes trips to Paulsboro, NJ), other project vessels will transit nearby to the Atlantic Shores WDA.

Site Assessment, Site Characterization, and Surveys

A number of geotechnical and geophysical surveys to support wind farm siting have occurred and will continue to occur in the action area. Additionally, data collection buoys have been installed. Effects of these activities on ESA listed species in the action area are related to potential exposure to noise associated with survey equipment, survey vessels, and habitat impacts. NMFS GARFO completed a programmatic informal consultation with BOEM in June 2021 that considered the effects of geotechnical and geophysical surveys and buoy deployments (NMFS GAR 2021, Appendix C to this Opinion). The consultation includes a number of best management practices and project design criteria designed to minimize the potential effects of these activities on ESA listed species. In the consultation, we concluded that these activities are not likely to adversely affect any ESA listed species if implemented in accordance with applicable BMPs and PDCs. Given the characteristics of the noise associated with survey equipment and the use of best management practices to limit exposure of listed species, including protected species observers, effects of survey noise on listed species have been determined to be extremely unlikely or insignificant. There is no information that indicates that the noise sources used for these surveys has the potential to result in injury, including hearing impairment, or mortality of any ESA listed species in the action area. Similarly, we have not anticipated any adverse effects to habitats or prey and do not anticipate any ESA listed species to be struck by survey vessels; risk is reduced by the slow speeds that survey vessels operate at, the use of lookouts, and incorporation of vessel strike avoidance measures.

Surveys to obtain data on fisheries resources have been undertaken in the larger action area to support OSW development. Some gear types used, including trawls and trap/pot, can entangle or capture ESA listed sea turtles, fish, and whales; captures of sea turtles and Atlantic sturgeon in gill net and trawl surveys operating outside of the action area have occurred. Risk can be reduced through avoiding certain times/areas, minimizing soak and tow times, and using gear designed to limit entanglement or reduce the potential for serious injury or mortality.

Consideration of Construction, Operation, and Decommissioning of Other OSW Projects
*As noted above, w*e have completed ESA consultation for two small OSW projects (CVOW Demonstration Project and Block Island Project) and a number of commercial scale projects to date. Complete information on the assessment of effects of these three projects is found in their respective Biological Opinions (Revolution Wind – 2023a, Ocean Wind 1 - NMFS 2023b, Empire Wind – NMFS 2023c, CVOW Commercial - NMFS 2023d, Sunrise - NMFS 2023e, South Fork Wind - NMFS 2021a, Vineyard Wind 1 - NMFS 2021b, CVOW - NMFS 2016, and Block Island - NMFS 2014). The Block Island and CVOW Pilot projects have been constructed and turbines are operational. Construction of the Vineyard Wind 1 and South Fork projects has begun and is expected to be complete prior to the beginning of construction of the Atlantic Shores South project. In the Biological Opinions prepared for these projects, we anticipated temporary loss of hearing sensitivity (TTS) and/or short term behavioral disturbance of ESA listed sea turtles and whales exposed to pile driving noise or UXO detonations resulting in take that meets the ESA definition of harassment and, in a few cases, anticipated permanent loss of hearing sensitivity (PTS) resulting in take that meets the definition of harm. The amount of incidental take exempted through project Biological Opinions is included below for the two projects that occur in the Atlantic Shores action area (Tables 6.2 and 6.3). In all of these Opinions, we concluded that effects of turbine operation, including operational noise and other effects on the environment would be insignificant. With the exception of mortality of Atlantic sturgeon and sea turtles in gillnet surveys included in some projects outside the action area, the only mortality anticipated is a small number of sea turtles and Atlantic sturgeon expected to be

struck and injured or killed by vessels associated with project vessels. No vessel strikes have been reported to date for any of these projects.

Given the migratory nature of the ESA listed species in the action area, it is possible that some individuals in the Atlantic Shores action area will transit near or through other lease areas (even outside the action area) and may be affected by project activities. Some individual whales or sea turtles migrating through the Atlantic Shores project area may have been exposed to construction noise from other offshore wind projects that resulted in minor, temporary or permanent effects to hearing sensitivity; however, as explained in the Effects Analysis in the respective Biological Opinions, those effects are not expected to affect communication or ability to detect acoustic cues in a way that would make individuals more vulnerable to effects of the Atlantic Shores project (e.g., an animal that experienced PTS or TTS as a result of exposure to pile driving noise from another offshore wind project is not less likely to detect and avoid noise resulting from the Atlantic Shores project).

We note that each of these lessees also obtained an Incidental Take Authorization under the MMPA; copies of these authorizations are available online (https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable).

Table 6.2. Amount and Extent of Take Exempted through CVOW and Ocean Wind 1 BiOp's ITS due to Noise Exposure (pile driving and/or UXO detonations). Note that not all anticipated construction periods overlap. Source: CVOW - NMFS 2023d, Ocean Wind 1 - NMFS 2023b.

Ocean Wind 1 - Amount and Extent of Take in the BiOp's ITS due to Noise Exposure (Scenario 2; UXO Detonation and Impact and Vibratory Pile Driving)		
Species	Harm (Auditory Injury - PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	7
Fin whale	4	15
Sei Whale	1	4
Sperm whale	None	9
Blue whale	None	4
NA DPS green sea turtle	None	1
Kemp’s ridley sea turtle	None	16
Leatherback sea turtle	None	7
NWA DPS Loggerhead sea turtle	None	184
CVOW Commercial - Amount and Extent of Take in the BiOp’s ITS due to Noise Exposure (Pile Driving)		
Species	Harm (Auditory Injury - PTS)	Harassment (TTS/Behavior)

North Atlantic right whale	None	12
Fin whale	7	202
Sei Whale	2	5
Sperm whale	None	6
NA DPS green sea turtle	46	215
Kemp's ridley sea turtle	44	203
Leatherback sea turtle	4	3
NWA DPS Loggerhead sea turtle	1,214	5,764

Table 6.3. Amount and Extent of Take Exempted in CVOW and Ocean Wind 1 BiOp's ITS due to vessel strikes. The amount of take identified is over the approximately 40-year life of each project (construction, operations, and decommissioning). Source: CVOW - NMFS 2023d, Ocean Wind 1 - NMFS 2023b.

Ocean Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	1
NWA DPS Loggerhead sea turtle	9
CVOW Commercial - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	13
Kemp's ridley sea turtle	101
Leatherback sea turtle	5
NWA DPS Loggerhead sea turtle	249
New York Bight DPS Atlantic sturgeon	113
Chesapeake Bay DPS Atlantic sturgeon	47
South Atlantic DPS Atlantic sturgeon	25
Carolina DPS Atlantic sturgeon	11
Gulf of Maine DPS Atlantic sturgeon	5

Other Activities in the Action Area

Other activities that occur in the action area that may affect listed species include scientific research and geophysical and geotechnical surveys. Military operations in the action area are expected to be restricted to vessel transits, the effects of which are subsumed in the discussion of vessel strikes above.

Scientific Surveys

Numerous scientific surveys, including fisheries and ecosystem surveys carried out by NMFS operate in the action area. Regulations issued to implement Section 10(a) (1)(A) of the ESA allow issuance of permits authorizing take of ESA listed species for the purposes of scientific research. Prior to the issuance of such a permit, an ESA Section 7 consultation must take place. No permit can be issued unless the proposed research is determined to be not likely to jeopardize the continued existence of any listed species. Scientific research permits are issued by NMFS for ESA listed whales and Atlantic sturgeon; the U.S. Fish and Wildlife Service is the permitting authority for ESA listed sea turtles.

Marine mammals, sea turtles, and Atlantic sturgeon have been the subject of field studies for decades. The primary objective of most of these field studies has generally been monitoring populations or gathering data for behavioral and ecological studies. Research on ESA listed whales, sea turtles, and Atlantic sturgeon has occurred in the action area in the past and is expected to continue over the life of the proposed action. Authorized research on ESA listed whales includes close vessel and aerial approaches, photographic identification, photogrammetry, biopsy sampling, tagging, ultrasound, exposure to acoustic activities, breath sampling, behavioral observations, passive acoustic recording, and underwater observation. No lethal interactions are anticipated in association with any of the permitted research. ESA listed sea turtle research includes approach, capture, handling, restraint, tagging, biopsy, blood or tissue sampling, lavage, ultrasound, imaging, antibiotic (tetracycline) injections, laparoscopy, and captive experiments. Most authorized take is sub-lethal with limited amounts of incidental mortality authorized in some permits. Authorized research for Atlantic sturgeon includes capture, collection, handling, restraint, internal and external tagging, blood or tissue sampling, gastric lavage, and collection of morphometric information. Most authorized take of Atlantic sturgeon for research activities is sub-lethal with small amounts of incidental mortality authorized; a programmatic ESA Section 7 consultation was issued in 2017 that identifies a limit on lethal take for each river population (NMFS OPR 2017); depending on the identified health of the river population, the allowable mortality limit, across all issued permits, ranges from 0.4 to 0.8%. In that Opinion, NMFS determined this was not likely to jeopardize the continued existence of any DPS.

Noise

The ESA listed species that occur in the action area are regularly exposed to several sources of anthropogenic sounds in the action area. The major source of anthropogenic noise in the action area are vessels. Other sources are minor and temporary including short-term dredging, construction, and research activities. As described in the DEIS, typically, military training exercises occur in deeper offshore waters southeast of the lease area, though transit of military vessels may occur throughout the area; therefore, while military operations can be a significant source of underwater noise that is not the case in the action area. ESA listed species may be impacted by either increased levels of anthropogenic-induced background sound or high intensity, short- term anthropogenic sounds.

The Atlantic Shores South WDA lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action, a diverse community of vocalizing cetaceans, and other organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes in proximity to the action area, also contribute ambient sound. While no ambient underwater noise measurements have been collected specifically for the Project area, Kraus et al. (2016) surveyed the ambient underwater noise environment in the RI/MA WEA, north of the WDA, as part of a broader study of large whale and sea turtle use of marine habitats in this wind energy development area. Acoustic monitoring sensor locations in and around the RI/MA WEA had water depths ranging from approximately 98 to 197 feet (30 to 60 meters), similar to the Project area, where water depths vary from 43 to 112 feet (13 to 34 meters). Figure 12 (in Kraus et al. 2016) displays 50th percentile power spectral density and cumulative percentile distribution of peak ambient sound levels measured between November 2011 and March 2015. Depending on location, ambient underwater sound levels within the RI/MA WEA varied from 96 to 103 dB in the 70.8- to 224-Hz frequency band at least 50% of the recording time, with peak ambient noise levels reaching as high as 125 dB in proximity to the Narraganset Bay and Buzzards Bay shipping lanes (Kraus et al. 2016). Low-frequency sound from large marine vessel traffic in these and other major shipping lanes to the east (Boston Harbor) and south (New York) were the dominant sources of underwater noise in the RI/MA WEA.

Short term increases in noise in the action area associated with vessel traffic and other activities, including geotechnical and geophysical surveys that have taken place in the past and will continue in the future in the portions of the action area that overlap with other offshore wind lease areas and/or potential cable routes. Exposure to these noise sources can result in temporary masking or temporary behavioral disturbance; however, in all cases, these effects are expected to be temporary and short term (e.g., the seconds to minutes it takes for a vessel to pass by) and not result in any injury or mortality in the action area. Outside of the Gulf of Mexico, no acoustic surveys using seismic equipment or airguns have been proposed in the action area and none are anticipated to take place in the future, as that equipment is not necessary to support siting of future offshore wind development that is anticipated to occur in the action area. Noise associated with oil and gas exploration is addressed below noise associated with construction and operations of other offshore wind projects is addressed above.

Factors Relevant only for the Gulf of Mexico portion of the Action Area

In addition to fishing activities and vessel operations, oil and gas exploration and extraction activities occur in the Gulf of Mexico as do a number of military activities. The air space over the Gulf of Mexico is used extensively by the Department of Defense for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of Mexico. The western Gulf of Mexico has four warning areas that are used for military operations. In addition, six blocks in the western Gulf of Mexico are used by the Navy for mine warfare testing and training. The central Gulf of Mexico has five designated military warning areas that are used for military operations. Oil and gas operations on the Gulf of Mexico OCS that have been ongoing for more than 50 years involve a variety of activities that may adversely affect ESA-listed species in the action area. These activities and resulting impacts include vessels making supply deliveries, drilling operations, seismic surveys, fluid spills, oil spills and response, and oil platform removals.

Other Factors
Whales, sea turtles, and Atlantic sturgeon are exposed to a number of other stressors in the action area that are widespread and not unique to the action area which makes it difficult to determine to what extent these species may be affected by past, present, and future exposure within the action area. These stressors include water quality and marine debris. Marine debris in some form is present in nearly all parts of the world's oceans, including the action area. While the action area is not known to aggregate marine debris as occurs in some parts of the world (e.g., The Great Pacific garbage patch, also described as the Pacific trash vortex, a gyre of marine debris particles in the north central Pacific Ocean), marine debris, including plastics that can be ingested and cause health problems in whales and sea turtles is expected to occur in the action area.

The Atlantic Shores South WFA and offshore export cables are located in offshore marine waters where available water quality data are limited. The EPA classified coastal water quality conditions nationally for the 2010 National Coastal Condition Assessment (EPA 2015). The 2010 National Coastal Condition Assessment used physical and chemical indicators to rate water quality, including phosphorus, nitrogen, dissolved oxygen, salinity, water clarity, pH, and chlorophyll *a*. The most recent National Coastal Condition Report rated coastal water quality from Maine to North Carolina as "good" to "fair" (EPA 2012). Broadly speaking, ambient water quality in these areas is expected to be generally representative of the regional ocean environment and subject to constant oceanic circulation that disperses, dilutes, and biodegrades anthropogenic pollutants from upland and shoreline sources (BOEM 2013).

A portion of the offshore export cable corridor is located in coastal New Jersey waters. The NJDEP conducts annual assessments of the state's waterways for water quality parameters. Five sampling sites within Barnegat Bay were in non-attainment for turbidity and considered impaired for this parameter as defined under the Clean Water Act Section 303(d) program. Water quality in Manahawkin Bay, Upper Little Egg Harbor, and Lower Little Egg Harbor Bay was designated as fully supporting recreation and shellfish but not supporting wildlife, due, in part, to increased turbidity (BOEM 2023).

Ocean waters beyond 3 miles (4.8 km) offshore typically have low concentrations of suspended particles and low turbidity. Waters along the Northeast Coast average 5.6 milligrams per liter (mg/L) of TSS, which is considered low. There are notable exceptions, including estuaries that average 27.4 mg/L, although TSS sampling throughout nine assessment units in and around Barnegat Bay did not record TSS levels above 16 mg/L (EPA 2012; BOEM 2023). While most ocean waters had TSS concentrations under 10 mg/L, which is the 90th percentile of all measured values, most estuarine waters (65.7% of the Northeast Coast area) had TSS concentrations above this level. Near-bottom TSS concentrations were similar to those near the water surface, averaging 6.9 mg/L. With the exception of the entrance to Delaware Bay, all other coastal ocean stations had near-bottom levels of TSS less than or equal to 16.3 mg/L (EPA 2012).

A study conducted by the EPA evaluated over 1,100 coastal locations in 2010, as reported in their National Coastal Condition Assessment (EPA, 2015). The EPA used a Water Quality Index (WQI) to determine the quality of various coastal areas including the northeast coast from

Virginia to Maine and assigned three condition levels for a number of constituents: good, fair, and poor. A number of the sample locations overlap with the action area. Chlorophyll a concentrations, an indicator of primary productivity, levels in northeastern coastal waters were generally rated as fair (45%) to good (51%) condition, and stations in the action area were all also fair to good (EPA, 2015). Nitrogen and phosphorous levels in northeastern coastal waters generally rated as fair to good (13% fair and 82% good for nitrogen and 62% and 26% good for phosphorous); stations in the action area were all also fair to good (EPA 2015). Dissolved oxygen levels in northeastern coastal waters are generally rated as fair (14%) to good (80%) condition, with consistent results for the sampling locations in the action area. Based on the available information, water quality in the action area appears to be consistent with surrounding areas. We are not aware of any discharges to the action area that would be expected to result in adverse effects to listed species or their prey. Outside of conditions related to climate change, discussed in Section 7.10, water quality is not anticipated to negatively affect negative listed species that may occur in the action area.

7.0 EFFECTS OF THE ACTION

This section of the biological opinion assesses the effects of the proposed action on ESA-listed threatened or endangered species and designated critical habitat (that was not addressed in section 4.0). Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR §402.02 and § 402.17).

The main element of the proposed action is BOEM’s proposed COP approval with conditions, the effects of which will be analyzed in this section. The effects of the issuance of other permits and authorizations that are consequences of BOEM’s proposed action (Section 3.0) are also evaluated in this section, including the Connected Action. For example, the ITA proposed by NMFS OPR to authorize incidental take of ESA-listed marine mammals under the MMPA and other permits proposed to be issued by USACE and EPA are considered effects of the action as they are consequences of BOEM’s proposal to approve Atlantic Shores’ COP with conditions. In addition, the ITA proposed by NMFS OPR, as well as permits proposed by USACE and EPA, are also Federal actions that may affect ESA-listed species; therefore, they require Section 7 consultation in their own right. In this consultation, we have worked with NMFS OPR as the action agency proposing to authorize marine mammal takes under the MMPA through the ITA, as well as with other Federal action agencies aside from BOEM that are proposing to issue permits or other approvals, and we have analyzed the effects of those actions along with the effects of BOEM's proposed action to approve the COP with conditions. We also consider the effects of the “Connected Action” involving rehabilitation/repair work to support an O&M facility at Atlantic City which the USACE is proposing to permit. All effects of these collective actions on ESA-listed species and designated critical habitat are, therefore, comprehensively analyzed in this Opinion.[35]

[35] The term “proposed action” or “action” may be used to refer to all action agencies’ actions related to the Atlantic Shores project, unless specific context reveals otherwise.

The purpose of the Atlantic Shores project is to generate electricity. Electricity will travel from the WTGs to the OSSs and then by submarine cable to on-land cables in New Jersey. As described in the COP, from this point, electricity generated at the WTGs would be distributed into the electrical grid at the Cardiff Substation point of interconnection (POI) in Egg Harbor Township, New Jersey and/or the Larrabee Substation POI in Howell, New Jersey. Even if we assume the project will increase overall supply of electricity, we are not aware of any new actions demanding electricity that would not be developed but for the Atlantic Shores project specifically. Because the electricity generated by Atlantic Shores 1 and 2 will be pooled with that of other sources in the power grid, we are unable to trace any particular new use of electricity to Atlantic Shores' contribution to the grid and, therefore, we cannot identify any impacts, positive or negative, that would occur because of the project's supply of electricity to the grid. As a result, there are no identifiable consequences of the proposed action related to the use of energy generated by the Atlantic Shores project analyzed in this Opinion that would not occur but for the project's production of electricity and are reasonably certain to occur.

Here, we examine the activities associated with the proposed action and determine what the consequences of the proposed action are to ESA-listed species and designated critical habitat. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. In analyzing effects, we evaluate whether a source of impacts is "likely to adversely affect" ESA-listed species/designated critical habitat or "not likely to adversely affect" ESA-listed species/designated critical habitat. A "not likely to adversely affect" determination is appropriate when an effect is expected to be discountable, insignificant, or completely beneficial. As discussed in the FWS-NMFS Joint Section 7 Consultation Handbook (1998), "[b]eneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. If an effect is beneficial, discountable, or insignificant it is not considered adverse and thus cannot cause "take" of any listed species. "Take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct" (ESA §3(19)).

7.1 Underwater Noise

In this section, we provide background information on underwater noise and how it may affect listed species, establish the underwater noise that listed species are likely to be exposed to as a result of the proposed action, and then establish the expected response of the individuals exposed to that noise. This analysis considers all phases of the proposed action inclusive of construction, operations, and decommissioning.

7.1.1 Background on Noise

This section contains a brief technical background on sound, the characteristics of certain sound types, and metrics used in this consultation inasmuch as the information is relevant to the specified activity and to consideration of the potential effects of the specified activity on listed species found later in this document.

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

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

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy in a stated frequency band over a stated time interval or event, and considers both intensity and duration of exposure. The per-pulse SEL is calculated over the time window containing the entire pulse (*i.e.*, 100 percent of the acoustic energy). SEL is a cumulative metric; it can be accumulated over a single pulse, or calculated over periods containing multiple pulses. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure.

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

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound, which is defined as environmental background sound levels lacking a single source or point (Richardson *et al*., 1995). The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.*, wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.*, sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.*, vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including wind and waves, which are a main source of naturally occurring ambient sound for frequencies between 200 hertz (Hz) and 50 kilohertz (kHz) (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, geophysical surveys, sonar, and explosions. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

The sum of the various natural and anthropogenic sound sources that comprise ambient sound at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 decibels (dB) from day to day (Richardson *et al*., 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect a particular species. As described in the BA, the WDA lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action, a diverse community of vocalizing cetaceans, and other organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes in proximity to the WDA, also contribute ambient sound; these sources are described in the *Environmental Baseline*.

Sounds are often considered to fall into one of two general types: pulsed and non-pulsed. The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward, 1997 in Southall *et al*., 2007). Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998).

Pulsed sound sources (*e.g.*, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, drilling or dredging, and vibratory pile driving.

Specific to pile driving, the impulsive sound generated by impact hammers is characterized by rapid rise times and high peak levels. Vibratory hammers produce non-impulsive, continuous noise at levels significantly lower than those produced by impact hammers. Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (e.g., Nedwell and Edwards, 2002; Carlson et al., 2005).

7.1.2 Summary of Available Information on Sources of Increased Underwater Noise

During the construction phase of the project, sources of increased underwater noise include pile driving, vessel operations, and other underwater construction activities (cable laying, placement of scour protection) as well as HRG surveys. During the operations and maintenance phase of the project, sources of increased underwater noise are expected to be limited to WTG operations, vessel operations, maintenance activities, and occasional HRG surveys. During decommissioning, sources of increased underwater noise include removal of project components and associated surveys, as well as vessel operations. Here, we present a summary of available information on these noise sources. More detailed information is presented in the acoustic reports produced for the project (Weirathmueller et al. 2023 - Appendix II-L1 to the COP); Atlantic Shores' Application for an ITA and update memos[36], the Proposed Rule prepared for the ITA (88 FR 65430; September 22, 2023), and BOEM's BA.

Impact Pile Driving for WTG and OSS Foundations

Pile driving for the installation of WTG, Met Tower, and OSS foundations would be limited to May 1 through December 31, given the proposed seasonal restriction on foundation impact pile driving from January 1-April 30. Foundation pile installation is expected to occur over two construction seasons, currently anticipated for May 1 – December 31, 2026 and May 1 – December 31, 2027. During this period, up to 200 WTG foundations, 10 OSS foundations, and 1 Met Tower foundation will be installed. All WTG foundations for Project 1 will be monopiles (12 or 15 m diameter), all WTG foundations for Project 2 will be monopiles (12 or 15 m diameter) or jacket foundations (four 5-m diameter pin piles each); that is, the WTG foundations for each Project will be a single type. The single met tower may be installed on a pile driven foundation (monopile, jacket) or a suction bucket jacket, mono-bucket, or gravity-based structure which does not require pile driving. The 4 to 10 OSSs (with the number depending on size) will be installed on monopile, piled jacket, suction bucket jacket, mono-bucket, or gravity based structures. Only monopile and piled jacket foundations involve pile driving. Considering the potential for some non-pile driven foundations, the total number of foundations to be installed with impact pile driving ranges from 200 to 211. For all construction scenarios, one or two monopiles or one jacket foundation (four pin piles) would be installed per day; no concurrent pile driving (i.e., driving of more than one pile at a time) is proposed.

[36] Available at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-atlantic-shores-offshore-wind-llc-construction-atlantic-shores

Monopiles would be installed using an impact pile driver to a maximum penetration depth of 60 m; conditions of the proposed MMPA ITA would limit the maximum hammer energy to 4,400 kJ. Installation of each monopile will include a 20-minute soft-start where lower hammer energy is used at the beginning of each pile installation. Atlantic Shores estimates that a 15-m monopile could require up to 15,387 strikes at a rate of up to 30 blows per minute (bpm) to reach the target penetration depth, while a 12-m monopile could require 12,350 total strikes at a rate of 30 bpm. Based on this strike rate, each monopile is estimated to take between 7 to 9 hours to install using an impact hammer. One or two monopiles will be installed per day with no overlapping or concurrent pile driving; that is, if a second monopile is installed in a 24-hour period, it will only be after pile driving for the first monopile is complete. Given that use of only one pile hammer is anticipated, it is likely that there will be down time between pile driving events when no pile driving is occurring.

For jacket foundations, pin piles would be installed using an impact hammer to reach a maximum penetration depth of 70 m. Each pin pile is expected to require approximately 3 hours of impact hammering (6,750 strikes at a rate of up to 30 bpm), inclusive of a 20 minute soft start period. A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seabed by means of hollow steel pin piles attached to the jacket. The piled jacket foundation will have four piles total. Conditions of the proposed MMPA ITA would limit the maximum hammer energy to 2,500 kJ. Installation of the jacket foundation would require 12 hours of pile driving total (3 hours per pile), which is expected to occur over a single day. The jacket piles are expected to be pre-piled (*i.e.,* the jacket structure will be set on pre-installed piles) or post-piled (*i.e.,* the jacket is placed on the seafloor and piles are subsequently driven through guides at the base of each leg).

As described in section 3.0 of this Opinion, in addition to seasonal restrictions on impact pile driving and requirements for use of a noise attenuation system, there are a number of other measures included as part of the proposed action that are designed to avoid or minimize exposure of ESA listed species to underwater noise. These measures are discussed in detail in the effects analysis below but generally include requirements for use of PSOs and PAM operators to maintain clearance and shutdown zones and ensuring adequate visibility for monitoring.

As described in the proposed MMPA ITA, Atlantic Shores is currently planning on only carrying out pile driving during the day; however, to maintain operational flexibility, Atlantic Shores has indicated they will prepare a night time monitoring plan (required by the proposed MMPA ITA and described in the BA as a proposed condition of COP approval) and if approved, may carry out pile driving after dark. To date, Atlantic Shores has not submitted a plan containing the information necessary, including evidence, that their proposed systems are capable of detecting marine mammals, particularly large whales, at night and at distances necessary to ensure mitigation measures are effective. We also note that BOEM will require submission of a monitoring plan for sea turtles; no such plan has been provided to date. As noted in the proposed MMPA ITA, the available information on traditional night vision technologies demonstrates that there is a high degree of uncertainty in reliably detecting marine mammals at night at the distances necessary for this project (Smultea *et al.*, 2021). It is also not clear that the technologies that may improve detectability for marine mammals at night (i.e., IR cameras, PAM) would improve detectability of sea turtles.

In the proposed MMPA ITA, NMFS OPR proposes to only allow Atlantic Shores to initiate pile driving during daylight hours and prohibit Atlantic Shores from initiating pile driving earlier than one hour after civil sunrise or later than 1.5 hours before civil sunset. NMFS OPR is proposing to condition the LOA such that nighttime pile driving would only be allowed if Atlantic Shores submits an Alternative Monitoring Plan (as part of the Pile Driving and Marine Mammal Monitoring Plan) to NMFS for approval that proves the efficacy of their night vision devices (*e.g.*, mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting protected marine mammals prior to making a determination in the final rule. The plan must include a full description of the proposed technology, monitoring methodology, and supporting data demonstrating the reliability and effectiveness of the proposed technology in detecting marine mammal(s) within the clearance and shutdown zones for monopiles before and during impact pile driving. The Plan should identify the efficacy of the technology at detecting marine mammals in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. As noted above, BOEM is requiring a complementary plan for their review, and review and approval by NMFS GARFO that will also require consideration of sea turtles. Given this, our effects analysis for this Opinion assumes that pile driving at night will only occur if the agencies have determined that the monitoring that will occur for pile driving initiated after dark will allow PSOs to effectively and reliably monitor the full extent of the identified clearance and shutdown zones for marine mammals and sea turtles such that the effects of pile driving will be the same at any time of day or night. We note that this may mean that additional PSOs and/or PSO platforms may be required at night to ensure detectability of whales and sea turtles in the identified clearance and shutdown zones in order to implement the required clearance and shutdown protocols, which will be the same regardless of the time of day or night that pile driving takes place.

Atlantic Shores would employ a noise attenuation system during all impact pile driving of monopile and jacket foundations. Noise attenuation systems, such as bubble curtains, are used to decrease the sound levels radiated from a source in an effort to reduce ranges to acoustic thresholds and minimize any acoustic impacts resulting from pile driving. Atlantic Shores is proposing, and BOEM proposes to require through conditions of COP approval, the use of a noise attenuation system designed to minimize the sound radiated from piles by at least 10 dB. This requirement is also a condition of the proposed MMPA ITA. This requirement will be in place for all foundation piles to be installed. As such, Atlantic Shores, BOEM, and NMFS OPR anticipate that the noise attenuation system ultimately chosen will be capable of reliably reducing source levels by 10 dB; therefore, modeling results assuming 10 dB attenuation were carried forward in the modeling of sound exposure for impact pile driving for foundation installation.

Consistent with the requirements of the proposed MMPA ITA, Atlantic Shores would be required to use at least two noise attenuation systems (NAS) to ensure that measured sound levels do not exceed the levels modeled for a 10-dB sound level reduction for foundation installation, which is likely to include a double big bubble curtain combined with another NAS (other available NAS technologies are the hydro-sound damper, or an AdBm Helmholz resonator), as well as the adjustment of operational protocols to minimize noise levels. A single bubble curtain, alone or in combination with another NAS device, may not be used for pile driving as received SFV data (e.g., Vineyard Wind 1 2023 SFV results) reveals this approach is unlikely to attenuate sound sufficiently to be consistent with the modeling underlying the effects analysis here. The noise attenuation system ultimately selected for the Project would be tailored to and optimized for site-specific conditions and reflect the requirements of the proposed MMPA ITA. As described in the proposed ITA, the noise attenuation system used would be required to attenuate pile driving noise such that measured ranges to isopleth distances corresponding to relevant marine mammal harassment thresholds (i.e. Level A and Level B harassment) are consistent with those modeled based on 10 dB attenuation, determined via sound field verification. Sound field verification will be required through BOEM's conditions of COP approval and NMFS OPR's proposed MMPA ITA. SFV involves monitoring underwater noise levels during pile driving to determine the actual distances to isopleths of concern (e.g., the distances to the noise levels equated to Level A and Level B harassment for marine mammals and injury and take by ESA harassment and injury (harm) of sea turtles and injury and behavioral disturbance of Atlantic sturgeon). Requirements will be in place through the MMPA ITA and BOEM's conditions of COP approval to implement adjustments to pile driving and/or additional or alternative sound attenuation measures for subsequent piles if any distances to any thresholds are exceeded. The goal of the SFV and associated requirements is to ensure that the actual distances to isopleths of concern do not exceed those modeled assuming 10 dB of sound attenuation as those are the noise levels/distances that are the foundation of the effects analysis carried out in this Opinion and the exposure analysis and take estimates in the proposed MMPA ITA. Failure to demonstrate through the required SFV that distances to these thresholds of concern as modeled with 10 dB attenuation can be met could lead to the need for reinitiation of this ESA consultation.

Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the bubbles determines their effective frequency band, with larger bubbles needed for lower frequencies. There are a variety of bubble curtain systems, confined or unconfined bubbles, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. As described in the proposed ITA, Atlantic Shores would be required to maintain the following operational parameters for bubble curtains: The bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 m^3 / (min*m), and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; no parts of the ring or other objects should prevent full seafloor contact. Atlantic Shores must require that construction contractors train personnel in the proper balancing of airflow to the bubble ring, and must require that construction contractors submit an inspection/performance report following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving of monopiles. If Atlantic Shores uses a noise mitigation device in addition to a BBC, similar quality control measures will be required.

As described in the BA, BOEM considers an attenuation level of 10 dB achievable using a joint mitigation approach of a double bubble curtain and another noise abatement system or a double bubble curtain. NMFS OPR will require, as described in the proposed MMPA ITA, the use of at least two NAS devices and has determined that a single bubble curtain, alone or in combination with another NAS device may not be used as it is unlikely to attenuate sound sufficiently. Based on our independent review of the available information, we agree with OPR's determination and note that this presumption will be verified through the required SFV.

As summarized in the MMPA ITA, Bellmann et al. (2020) found three noise abatement systems to have proven effectiveness and be offshore suitable: 1) the near-to-pile noise abatement systems - noise mitigation screen (IHC-NMS); 2) the near-to-pile hydro sound damper (HSD); and 3) for a far-from-pile noise abatement system, the single and double big bubble curtain (BBC and dBBC). With the IHC-NMS or the BBC, noise reductions of approximately 15 to 17 dB in depths of 82 to 131 feet (25 to 40 meters) could be achieved. The HSD system, independent of the water depth, demonstrated noise reductions of 10 dB with an optimum system design. The achieved broadband noise reduction with a BBC or dBBC was dependent on the technical-constructive system configuration. *In situ* measurements during installation of large monopiles (approximately 8 m) for more than 150 WTGs in comparable water depths (greater than 25 m) and conditions in Europe indicate that attenuation levels of 10 dB are readily achieved (Bellmann, 2019; Bellmann *et al.*, 2020) using single BBCs as a noise abatement system. The Coastal Virginia Offshore Wind (CVOW) pilot project systematically measured noise resulting from the impact driven installation of two 7.8 m monopiles, one with a noise abatement system (double big bubble curtain (dBBC)) and one without (CVOW, unpublished data). Although many factors contributed to variability in received levels throughout the installation of the piles (*e.g.*, hammer energy, technical challenges during operation of the dBBC), reduction in broadband SEL using the dBBC (comparing measurements derived from the mitigated and the unmitigated monopiles) ranged from approximately 9 to 15 dB. The effectiveness of the dBBC as a noise mitigation measure was found to be frequency dependent, reaching a maximum around 1 kHz; this finding is consistent with other studies (*e.g.*, Bellman, 2014; Bellman *et al*., 2020).

As of the writing of this Opinion, we have received sound field verification reports for monopiles installed for the South Fork project; these results indicate that the required sound attenuation systems are capable of reducing noise levels to the distances predicted by modeling assuming 10 dB attenuation. We note that South Fork deployed a double bubble curtain and a near field noise attenuation device. We have also received interim SFV reports for the first 12 monopiles and the jacket foundation for the Vineyard Wind project; these results also indicate that a double bubble curtain and near field sound attenuation device are capable of reducing noise levels to the distances predicted by modeling (note that the Vineyard Wind modeling assumed 6 dB attenuation). Results from both projects have indicated that actual noise is inconsistent between piles installed with similar methodology and location, and the importance of proper deployment and maintenance of the bubble curtains in obtaining expected sound attenuation results. These results also suggest that it may not be reasonable to expect that sound field verification results from a small subset of piles will be truly representative of noise produced during all subsequent piles due to differences in noise source and attenuation, at least in part related to functionality of the noise attenuation system.

Atlantic Shores carried out acoustic modeling to estimate sound fields produced during pile driving and to estimate exposures of marine mammals and sea turtles to noise above identified thresholds (Weirathmueller et al. 2023, COP Appendix II-L). A full summary of modeling, including source and sound propagation is provided in the proposed MMPA ITA. Due to seasonal changes in the water column, sound propagation is likely to differ at different times of the year. To capture this variability, acoustic modeling was conducted using an average sound speed profile for a "summer" period including the months of May through November, and a "winter" period including December through April (noting that impact pile driving is prohibited January – April). Acoustic propagation modeling for impact pile driving foundations was conducted using an average sound speed profile for a summer period given this would be when Atlantic Shores would conduct the majority, if not all of its foundation installation work. Sounds produced by installation of the proposed monopiles and pin piles were modeled at two sites (L01 and L02) for the 12-m and 15-m diameter monopile foundations and for the 5-m pin piles for jacket foundations. L01 is located in the southern section of the Lease Area in 36.1 m (118.4 ft.) of water depth and L02 in the northeastern section of the Lease Area in 28.1 m (92.2 ft.) of water depth. Modeling locations are shown in Figure 2 of Appendix B in the ITA application.

Key modeling assumptions for the monopiles and pin piles are listed in Table 7 of the proposed MMPA ITA (Table 7.1.1 below). Hammer energy schedules for monopiles (12-m and 15-m) and pin piles (5-m) are provided in Table 8 of the proposed MMPA ITA (Table 7.1.2 below). Within these assumptions, jacket foundations were assumed to be pre- and post-piled. Pre-piled means that the jacket structure is set on pre-installed piles while post-piling means that that jacket structure is placed on the seafloor and the piles are subsequently driven through guides located at the base of each jacket leg. Due to these installation approaches, the jacket structure itself radiates sound, which needs to be accounted for in the modeling. Because of this, a larger broadband sound level for the piles (+2 dB) for the post-piling scenario was incorporated into the modeling.

Table 7.1.1 Key Piling Assumptions Used in the Source Modeling

Foundation Type	Maximum Impact Hammer Energy (kJ)	Wall Thickness (mm)	Pile Length (m)	Seabed Penetration Depth (m)	Number Per Day
12-m Monopile Foundation	4,400	130	101	60	2
15-m Monopile Foundation	4,400	162	105	60	2
5-m Pin Pile for Jacket Foundation	2,500	72	76	70	4

source: Table 7 in the Proposed MMPA ITA

Table 7.1.2 Hammer Energy Schedules for Monopiles and Pin Piles Used in Source Modeling

Modeled	Hammer Model	Energy Level	Strike Count	Pile Penetration	Strike Rate

Installation Scenario		(kJ)		Range (m)	(strikes/min)
12-m Monopile Foundation	Menck MHU 4400S	1,400	750	5	30
		1,800	1,250	5	
		2,000	4,650	15	
		3,000	4,200	15	
		4,400	1,500	5	
		Total:	12,350	45	
15-m Monopile Foundation	Menck MHU 4400S	480	1,438	8	30
		800	1,217	3	
		1,600	1,472	4	
		2,500	2,200	5	
		3,000	4,200	10	
		4,000	2,880	9	
		4,400	1,980	6	
		Total:	15,387	45	
5-m Pin Piles for Jacket Foundation	IHC S-2500	1,200	700	10	30
		1,400	2,200	20	
		1,800	2,100	15	
		2,500	1,750	10	

		Total:	6,750	55	

source: Table 8 in Proposed MMPA ITA

After calculating source levels, Atlantic Shores used propagation models to estimate distances to identified thresholds for different species groups. Acoustic propagation modeling for impact pile driving applied 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 transmission loss model. See Appendix B and D in Atlantic Shores' MMPA ITA application (and supplemental memos) for more detailed descriptions of JASCO's propagation models.

Animal Movement Modeling

To estimate the probability of exposure of sea turtles and marine mammals to sound during foundation installation, JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) was used to integrate the sound fields generated from the source and propagation models described above with species-typical behavioral parameters (*e.g.*, dive patterns). Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3-D sound fields with movement rules derived from animal observations. Animats that exceed NMFS' acoustic thresholds (summarized below) are identified and the range for the exceedances determined. The output of the simulation is the exposure history for each animat within the simulation, and the combined history of all animats gives a probability density function of exposure during the project. The number of animals expected to exceed the identified thresholds is determined by scaling the probability of exposure by the species-specific density of animals in the area. By programming animats to behave like marine species that may be present near the lease area, the sound fields are sampled in a manner similar to that expected for real animals. The parameters used for forecasting realistic behaviors (*e.g.*, diving, foraging, and surface times) were determined and interpreted from marine species studies (*e.g.*, tagging studies) where available, or reasonably extrapolated from related species (Weirathmueller *et al*., 2023).

For modeled animals that have received enough acoustic energy to exceed a given harassment threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. The resulting exposure range for each species is the 95th percentile of the CPA distances for all animals that exceeded threshold levels for that species (termed the 95 percent exposure range ($ER_{95\%}$)). The $ER_{95\%}$ ranges are species-specific rather than categorized only by any functional hearing group, which allows for the incorporation of more species-specific biological parameters (*e.g.*, dive durations, swim speeds, *etc.*) for assessing the impact ranges into the model. NMFS OPR used these exposure range estimates when considering exposure of marine mammals above the cumulative Level A harassment threshold. This approach was also used by Atlantic Shores and BOEM to consider exposure of sea turtles above the cumulative injury threshold.

Atlantic Shores also calculated acoustic ranges, which represent the distance to an identified threshold based on sound propagation through the environment (*i.e*., independent of any receiver) while exposure range considers received levels in consideration of how an animal moves through the environment which influences the duration of exposure. As described above, applying animal movement and behavior within the modeled noise fields allows for a more realistic indication of the distances at which PTS acoustic thresholds are reached that considers the accumulation of sound over different durations. Because NMFS peak Level A and Level B harassment threshold for marine mammals is an instantaneous exposure, acoustic ranges were used for the analysis when considered these thresholds. Acoustic ranges were also used for consideration of exposure to sea turtles to the peak injury threshold and the behavioral disturbance threshold. Additionally, because information is not available to support animat modeling for Atlantic sturgeon, acoustic ranges were also used by Atlantic Shores and BOEM when considering exposure of Atlantic sturgeon to noise above the cumulative injury threshold.

Results of the modeling for ESA listed whales, sea turtles, and fish are included in the species group analyses below where we describe anticipated pile driving noise in more detail and assess the effects on those species.

Cable Landfall

To support cable landfall, up to four temporary sheet pile cofferdams will be installed (and removed) at each of the two landfall locations using a vibratory hammer. Each cofferdam would be composed of approximately 109 sheet piles, with a total of 872 sheet piles for all 8 cofferdams combined. Atlantic Shores estimates they can install or remove approximately 13–14 sheet piles per day, assuming 8 hours of vibratory pile driving would occur within any 24-hour period. Up to 16 days of work (8 days to install, 8 days to remove) would be required for all cofferdams at the Monmouth landfall site and up to 12 days of work (6 days to install, 6 days to remove) would be necessary for all cofferdams at the Atlantic landfall site. In total, to install and remove all eight cofferdams across both sites, 28 days of vibratory hammering/removal would need to occur. Cofferdam installation would only occur between Labor Day and Memorial Day (i.e., between early September and late May). Consistent with the requirements of the proposed MMPA ITA, Atlantic Shores will maintain a 100 m clearance zone (and 100 m shutdown zone) for vibratory pile driving of the sheet piles. Vibratory pile driving is only proposed during daylight.

For temporary cofferdams, simpler propagation modeling using *in-situ* data was performed using information from Illingworth & Rodkin (2017), which measured the sound exposure level at 10 m (32.8 ft.) distance from the pile for sheet piles using a vibratory hammer. JASCO used the source spectrum produced from this study (see Figure 2 in MMPA ITA Appendix D, the revised cofferdam memo) to define the expected source characteristics during Atlantic Shores' cofferdam installation and removal activities. JASCO's model, MONM, was used to predict the SEL and SPL fields at representative locations near the proposed cofferdam locations, considering the influences of bathymetry, seabed properties, water sound speed, and water attenuation. Sheet piles were represented as a point source at a depth of 2 m (6.56 ft.). Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

Bulkhead – Atlantic City
As explained in section 3, as part of the Connected Action, an existing sheet pile bulkhead located within an existing marina basin at Atlantic City will be repaired/rehabilitated through the installation of approximately 356 linear feet of steel or vinyl sheet piles with a vibratory hammer. The installation schedule (13 to 14 48" piles per day) is expected to be similar to installation of piles for the cofferdams; therefore, approximately 6 to 7 days of pile driving is anticipated to install the approximately 89 sheet piles. At this time, no time of year restrictions have been identified for this work. This work is expected to occur during daylight. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

Vessel Noise
Vessel noise is considered a continuous noise source that will occur intermittently. Vessels transmit noise through water primarily through propeller cavitation, although other ancillary noises may be produced. The intensity of noise from vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. Radiated noise from ships varies depending on the nature, size, and speed of the ship. McKenna et al. (2012b) determined that container ships produced broadband source levels around 177 to 188 dB re 1 µPa and a typical fishing vessel radiates noise at a source level of about 158 dB re 1 µPa (Mintz and Filadelfo 2011c; Richardson et al. 1995b; Urick 1983b). Noise levels generated by larger construction and installation and O&M would have an approximate *L*rms source level of 170 dB re 1 µPa-m (Denes et al. 2020). Smaller construction and installation and O&M vessels, such as CTVs, are expected to have source levels of approximately 160 dB re 1 µPa-m, based on observed noise levels generated by working commercial vessels of similar size and class (Kipple and Gabriele 2003; Takahashi et al. 2019).

Typical large vessel ship-radiated noise is dominated by tonals related to blade and shaft sources at frequencies below about 50 Hz and by broadband components related to cavitation and flow noise at higher frequencies (approximately around the one-third octave band centered at 100 Hz) (Mintz and Filadelfo 2011c; Richardson et al. 1995b; Urick 1983b). The acoustic signature produced by a vessel varies based on the type of vessel (e.g., tanker, bulk carrier, tug, container ship) and vessel characteristics (e.g., engine specifications, propeller dimensions and number, length, draft, hull shape, gross tonnage, speed). Bulk carrier noise is predominantly near 100 Hz while container ship and tanker noise is predominantly below 40 Hz (McKenna et al. 2012b). Small craft types will emit higher-frequency noise (between 1 kHz and 50 kHz) than larger ships (below 1 kHz). Large shipping vessels and tankers produce lower frequency noise with a primary energy near 40 Hz and underwater SLs for these commercial vessels generally range from 177 to 188 decibels referenced to 1 micropascal at 1 meter (dB re 1 µPa m) (McKenna et al., 2012). Smaller vessels typically produce higher frequency sound (1,000 to 5,000 Hz) at SLs of 150 to 180 dB re 1 µPa m (Kipple and Gabriele, 2003; Kipple and Gabriele, 2004).

As part of various construction related activities, including cable laying and construction material delivery, dynamic positioning thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of dynamic positioning thrusters is similar to that produced by transiting vessels, and dynamic positioning thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities.

Dynamically positioned (DP) vessels use thrusters to maneuver and maintain station, and generate substantial underwater noise with apparent SLs ranging from SPL 150 to 180 dB re 1 µPa depending on operations and thruster use (BOEM 2014, McPherson et al., 2016). Acoustic propagation modeling calculations for DP vessel operations were completed by JASCO Applied Sciences, Inc. for two representative locations for pile foundation construction at the South Fork Wind Farm based on a 107 m DP vessel equipped with six thrusters (Denes et al., 2021a). Unweighted root-mean square sound pressure levels (SPLrms) ranged from 166 dB re one µPa at 50 m from the vessel (CSA 2021). Noise from vessels used for the Atlantic Shores project are expected to be similar in frequency and source level. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

Cable Installation

Noise produced during cable laying includes dynamic positioning (DP) thruster use. Nedwell et al. (2003) reports a sound source level for cable trenching operations in the marine environment of 178 dB re 1µPa at a distance of 1m from the source. Hale (2018) reports on unpublished information for cable jetting operations indicating a comparable sound source level, concentrated in the frequency range of 1 kHz to 15 kHz and notes that the sounds of cable burial were attributed to cavitation bubbles as the water jets passed through the leading edge of the burial plow. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

WTG Operations

As described in BOEM's BA, once operational, offshore wind turbines produce continuous, non-impulsive underwater noise, primarily in the lower-frequency bands (below 1 kHz; Thomsen et al. 2006); vibrations from the WTG drivetrain and power generator would be transmitted into the steel monopile foundation generating underwater noise. Most of the currently available information on operational noise from turbines is based on monitoring of existing windfarms in Europe or from small turbines (e.g., Yoon et al. 2023 reports measurements from 3 MW turbines operating off the Korean coast). Although useful for characterizing the general range of WTG operational noise effects, this information is drawn from studies of older generation WTGs that operate with gearboxes and is not necessarily representative of current generation direct-drive systems (Elliot et al. 2019; Tougaard et al. 2020). Studies indicate that the typical noise levels produced by older-generation WTGs with gearboxes range from 110 to 130 dB RMS with 1/3-octave bands in the 12.5- to 500-Hz range, sometimes louder under extreme operating conditions such as higher wind conditions (Betke et al. 2004; Jansen and de Jong 2016; Madsen et al. 2006; Marmo et al. 2013; Nedwell and Howell 2004; Tougaard et al. 2009). Operational noise increases concurrently with ambient noise (from wind and waves), meaning that noise levels usually remain indistinguishable from background within a short distance from the source under typical operating conditions.

Tougaard et al. (2020) concluded that operational noise from multiple WTGs could elevate noise levels within a few kilometers of large windfarm operations under very low ambient noise conditions. Tougaard et al. (2020) caution that their analysis is based on monitoring data for older generation WTG designs that are not necessarily representative of the noise levels produced by modern direct-drive systems (such as those that will be installed for Atlantic Shores), which are considerably quieter. However, even with these louder systems, Tougaard further stated that the operational noise produced from WTGs is static in nature and is lower than noise produced from passing ships; operational noise levels are likely lower than those ambient levels already present in active shipping lanes, meaning that any operational noise levels would likely only be detected at a very close proximity to the WTG (Thomsen et al., 2006; Tougaard et al., 2020).

Stober and Thomsen (2021) summarized data on operational noise from offshore wind farms with 0.45 – 6.15 MW turbines based on published measurements and simulations from gray literature then used modeling to predict underwater operational noise levels associated with a theoretical 10 MW turbine. Using generic transmission loss calculations, they then predicted distances to various noise levels including 120 dB re 1uPa RMS. The authors note that there is unresolved uncertainty in their methods because the measurements were carried out at different water depths and using different methods that might have an effect on the recorded sound levels. Given this uncertainty, it is questionable how reliably this model predicts actual underwater noise levels for any operating wind turbines. The authors did not do any in-field measurements to validate their predictions and we are not aware of any field validation that has occurred following the publication of the paper. Additionally, the authors noted that all impact ranges (i.e., the predicted distance to thresholds) come with very high uncertainties. Using this methodology, they used the sound levels reported for the Block Island Wind Farm turbines in Elliot et al. 2019 and estimated the noise that would be produced by a theoretical 10 MW direct-drive WTG would be above120 dB re 1uPa RMS at a distance of up to 1.4 km from the turbine. However, it is important to note that this desktop calculation, using values reported from different windfarms under different conditions, is not based on in situ evaluation of underwater noise of a 10 MW direct-drive turbine, and has not been validated. Further, we note that context is critical to the reported noise levels evaluated in this study as well as for any resulting predictions. Without information on soundscape, water depth, sediment type, wind speed, and other factors, it is not possible to determine the reliability of any predictions from the Stober and Thomsen (2021) paper to the Atlantic Shores project up to the expected 15 MW direct drive turbines) or any other 10 MW or larger turbine. Further, as noted by Tougaard et al. (2020), as the turbines also become higher with larger capacity, the distance from the noise source in the nacelle to the water becomes larger too, and with the mechanical resonances of the tower and foundation likely to change with size as well, it is not straightforward to predict changes to the noise with increasing sizes of the turbines. Therefore, for the reasons provided above, Stober and Thomsen (2021) is not considered the best available scientific information on underwater noise likely to result from operation of 10 MW or larger turbines. We also note that Tougaard et al. (2020) and Stober and Thomsen (2021) both note that operational noise is less than shipping noise; this suggests that in areas with consistent vessel traffic, such as the Atlantic Shores lease area, operational noise may not be detectable above ambient noise.

Elliot et al. (2019) summarized findings from hydroacoustic monitoring of operational noise from the Block Island Wind Farm (BIWF). The BIWF is composed of five GE Haliade 150 6-MW direct-drive WTGs on jacketed foundations located approximately 250 km northeast of the proposed Atlantic Shores WFA. We note that Tougaard (2020) reported that in situ assessments have not revealed any systematic differences between noise from turbines with different foundation types (Madsen et al., 2006); thus, the difference in foundation type is not expected to influence underwater noise from operations. Underwater noise monitoring took place from

December 20, 2016 – January 7, 2017 and July 15 – November 3, 2017. Elliot et al. (2019) also presents measurements comparing underwater noise associated with operations of the direct-drive turbines at the BIWF to underwater noise reported at wind farms in Europe using older WTGs with gearboxes and conclude that absent the noise from the gears, the direct-drive models are quieter.

Elliot et al. (2019) presented a representative high operational noise scenario at an observed wind speed of 15 m/s (approximately 54 km/h, which is two to three times the average annual wind speed in the Atlantic Shores Wind WFA (COP Volume II)), which is summarized in Table 7.1.3 below. As shown, the BIWF WTGs produced frequency weighted instantaneous noise levels of 103 and 79 dB SEL for the LFC and MFC marine mammal hearing groups in the 10-Hz to 8-kHz frequency band, respectively. Frequency weighted noise levels for the LFC and MFC hearing groups were higher for the 10-Hz to 20-kHz frequency band at 122.5- and 123.3-dB SEL, respectively.

Table 7.1.3. Frequency weighted underwater noise levels, based on NMFS 2018, at 50 m from an operational 6-MW WTG at the Block Island Wind Farm

Species Hearing Group	Instantaneous dB SEL*		Cumulative dB SEL†	
	10 Hz to 8 kHz	10 Hz to 20 kHz	10 Hz to 8 kHz	10 Hz to 20 kHz
Unweighted	121.2	127.1	170.6	176.5
LFC (North Atlantic right whale, fin whale, sei whale)	103.0	122.5	152.4	171.9
MFC (sperm whale)	79.0	123.3	128.4	172.7

Source: Elliot et al. (2019)
* 1-second SEL re 1 µPaS2 at 15 m/s (33 mph) wind speed. 1sec SEL = RMS
† Cumulative SEL re 1 µPaS2 assuming continuous 24 exposure at 50 m from WTG foundation operating at 15 m/s.

Elliot et al. (2019) also summarizes sound levels sampled over the full survey duration. These averages used data sampled between 10 PM and 10 AM each day to reduce the risk of sound contamination from passing vessels. The loudest noise recorded was 126 dB re 1uPa at 50 m from the turbine when wind speeds exceeded 56 km/h; at wind speeds of 43.2 km/h and less, measured noise did not exceed 120 dB re 1uPa at 50 m from the turbine. As indicated by data from the nearby Ambrose Buoy maintained by NOAA's National Data Buoy Center (November 2008 – February 2023), instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, with wind speeds exceeding 40 km/h less than 3% of the time across a year[37].

Table 7.1.4. Summary of unweighted SPL RMS average sound levels (10 Hz to 8 kHz) measured at 50 m (164 ft.) from WTG 5

[37] https://www.windfinder.com/windstatistics/ambrose_buoy. and https://www.ndbc.noaa.gov/station_page.php?station=44065; last accessed March 30, 2023

Wind speed (Km/h)	Overall average sound level, dB re 1 µPa
7.2	112.2
14.4	113.1
21.6	114
28.8	115.1
36	116.7
43.2	119.5
46.8	120.6
Average over survey duration	119
Background sound levels in calm conditions	107.4 [30 km from turbine]
	110.2 [50 m from turbine]

Reproduced from Elliot et al. (2019); wind speeds reported as m/s converted to km/h for ease of reference

The WTGs proposed for Atlantic Shores will use the newer, direct-drive technology. Given that direct-drive turbines are considerably quieter than geared turbines (Tougaard et al. 2020) it is not reasonable to use measured or predicted sound levels based on direct-drive turbines to predict operational noise from the Atlantic Shores turbines. Additionally, given the shortcomings with modeled predictions in Stober and Thompsen 2021 (several of which are noted in that paper), we consider Elliot et al. 2019 and HDR 2023 to represent the best available data on operational noise that can be expected from the operation of the Atlantic Shores turbines. We acknowledge that as the Atlantic Shores turbines will have a greater capacity (up to 15 MW) than the turbines at Block Island and CVOW Demo there is some uncertainty in operational noise levels. However, we note that numerous scientific papers, including Tougaard et al. 2020 and Stober and Thompsen 2021, that predict greater operational noise from larger turbines note that operational noise is less than shipping noise; this suggests that in areas with consistent vessel traffic, such as the Atlantic Shores lease area, operational noise may not be detectable above ambient noise and, therefore, would be unlikely to result in any behavioral response by any whale, sea turtle, or sturgeon.

HDR 2023[38] reports acoustic recordings of operational noise from the two 12-MW turbines installed as part of the CVOW Demo project in 2020. Under BOEM's RODEO Program, PAM data were recorded over approximately 40 days (December 13, 2021 to January 24, 2022) to measure and analyze underwater sound levels within the water column and seafloor sediment vibrations generated by the revolving turbines. A complete description of the monitoring is included in HDR 2023; the report also contains depth, temperature, salinity, and sound speed data. Data analysis indicated that underwater sound levels recorded (approximately 350 m from Turbine A02) during turbine operations at CVOW were relatively low (the received levels ranged between 120 and 130 dB re 1 µPa, except during storms when the received levels

[38] OCS Study BOEM 2023-033; Available at: https://www.govinfo.gov/content/pkg/GOVPUB-I-152da72742e9c7acedf499bd3681252e/pdf/GOVPUB-I-152da72742e9c7acedf499bd3681252e.pdf

increased to 145 dB re 1 µPa). Recorded particle acceleration levels were also low. These were compared to published behavioral audiograms of selected fish (e.g., Atlantic salmon, dab, Atlantic cod, plaice) and found to be below the hearing threshold of these fish. Overall, all recorded measurements were below the temporary threshold shift (TTS) and permanent threshold shift (PTS) onset criteria included in NMFS 2018. The authors note that operational phase sound levels recorded at CVOW were measurably higher than those previously recorded at the BIWF at frequencies below approximately 120 Hz. They hypothesize that the higher operational noise recorded at CVOW is due to vibrations in the monopile structures. The BIWF foundations are lattice-jacket structures with four legs and have no detectable structural vibrations. The authors note that it is possible that CVOW monopile foundations vibrate when the turbines are operating, and the vibrational energy is transmitted into the water column and seabed; the authors state that this hypothesis needs additional investigation, both for the structural vibration mechanisms and potential biological effects. At frequencies above 120 Hz, CVOW's operational phase monitoring results are broadly consistent with operational phase acoustic monitoring previously conducted at wind farms in the U.S. (BIWF) and Europe. At the BIWF, for example, underwater sound levels recorded at 50 m from operational turbines were near background (ambient) levels, and often not measurable due to other natural and anthropogenic noise (waves or boat sounds) (HDR 2019). The authors conclude that the risk of negative impacts to protected marine species such as marine mammals are expected to be minor, as low noise levels make injury or masking highly unlikely. Assessments of exposure by these species to operational noise is addressed in the species group sections below.

High-Resolution Geophysical Surveys
As part of the proposed action for consultation in this opinion described in Section 3, Atlantic Shores plans to conduct HRG surveys in the WDA, including along the export cable routes to landfall locations in New Jersey intermittently through the construction and operation periods. Equipment planned for use includes multibeam echosounders, side scan sonars, shallow penetration sub-bottom profilers (SBPs) (*e.g.*, CHIRP non-parametric SBP), medium penetration sub-bottom profilers (e.g., sparkers), and ultra-short baseline positioning equipment. Atlantic Shores estimates 60 days of survey activities would occur each year.

As noted in Section 3, BOEM has completed a programmatic informal ESA consultation with NMFS for HRG surveys and other types of survey and monitoring activities supporting offshore wind energy development (NMFS 2021a; Appendix C to this Opinion). The equipment proposed for the Atlantic Shores HRG surveys is consistent with the survey equipment considered in that programmatic consultation. A number of measures to minimize effects to ESA listed species during HRG operations are proposed to be required by BOEM as conditions of COP approval and by NMFS OPR as conditions of the proposed MMPA ITA (see section 3.0 and Appendix A and B). As described in the BA, BOEM will require Atlantic Shores to comply with all relevant programmatic survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA consultation; these measures are detailed in Appendix B of the programmatic consultation). HRG surveys related to the approval of the Atlantic Shores COP are considered part of the proposed action evaluated in this Opinion and the applicable survey and monitoring PDCs and BMPs included in the 2021 informal programmatic ESA consultation are incorporated by reference. They are thus also considered components of the proposed action evaluated in this Opinion.

All noise producing survey equipment is secured to the survey vessel or towed behind a survey vessel and is only turned on when the vessel is traveling along survey transects; thus, the area ensonified is constantly moving, making survey noise transient and intermittent. The maximum anticipated distances from the HRG sound sources to noise thresholds of concern are presented in the tables below. The information on these noise sources is consistent with the information and effects analysis contained in the above referenced programmatic consultation.

Consistent with conclusions made by BOEM, and by NMFS OPR in the Notice of Proposed ITA, operation of some survey equipment types is not reasonably expected to result in any effects to ESA listed species in the area. Parametric sub-bottom profilers (SBP), also called sediment echosounders, generate short, very narrow-beam (1° to 3.5°) signals at high frequencies (generally around 85-100 kHz). The narrow beamwidth significantly reduces the potential that an individual animal could be exposed to the signal, while the high frequency of operation means that the signal is rapidly attenuated in seawater. Ultra-Short Baseline (USBL) positioning systems produce extremely small acoustic propagation distances in their typical operating configuration. The single beam and Multibeam Echosounders (MBES), side-scan sonar, and the magnetometer/gradiometer that may be used in these surveys all have operating frequencies >180 kilohertz (kHz) and are therefore outside the general hearing range of ESA listed species that may occur in the survey area. This is consistent with the conclusions made in the above referenced programmatic consultation. Table 2 of the MMPA ITA identifies all the representative survey equipment that may be used in support of planned geophysical survey activities.

Table 7.1.5 identifies all the representative survey equipment that operate below 180 kilohertz (kHz) (*i.e.*, at frequencies that may be audible to the different ESA listed species in the action area) that is proposed for use in planned geophysical survey activities. Equipment with operating frequencies above 180 kHz and equipment that does not have an acoustic output (*e.g.*, magnetometers) will also be used but are not discussed further because they are outside the general hearing range of ESA listed species in the action area or do not produce noise and thus will have no effect on such species.

Table 7.1.5 Summary of Representative HRG Survey Equipment

HRG Survey Equipment (Sub-bottom Profiler)	Representative Equipment Type	Operating Frequency Ranges (kHz)	Operational Source Level Ranges (dB_{RMS})	Beamwidth Ranges (degrees)	Typical Pulse durations RMS_{90} (millisecond)	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	195[b]	180	7.2[b]	0.41
Compressed High-	Edgetech 2000-DSS*	2 to 16	195[c]	24[d]	6.3	10

Intensity Radiated Pulses (CHIRP)	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	2[d]	2	40
	INNOMAR deep-36 Parametric[h]	30 to 42	245	1.5	0.15 to 5	40
Gradiometer	Geometrics G-882 Marine Magnetometer Transverse Gradiometer Array	n/a	n/a	n/a	n/a	n/a
Side-scan Sonar	EdgeTech 4200	100 or 400	201 at 100 kHz; 205 at 400 kHz	0.5° x 5 0° - 0.26° x 50°	1.1 to 7.2 at 100 kHz; 1.1 to 1.3 at 400 kHz	5 to 11 or 5 to 20 dependent on pulse duration
	Edgetech 4205 Tri-Freq	300, 600, or 900	220 at 300 kHz; 2019 at 600 kHz; 221 at 900 kHz	0.5° x 50° - 0.26° x 50°	1.0 to 3.0 at 300 kHz; 0.5 to 5.0 at 600 kHz; 0.4-2.8 at 900 kHz	5 to 11 or 10 to 25 dependent on pulse duration
Multibeam Echosounder	Dual Head Kongsberg EM2040	200 to 400	204.5	0.4 to 1.5	0.014 to 12	50
	Norbit iWMBS	200 to 700	220	0.5 to 1.9	0.5	Up to 60

source: Table 2 in the Proposed MMPA ITA

*Note: RMS stands for root mean square, SPL stands for sound pressure level; * = Sources expected to cause take of marine mammals and that were carried forward into the take estimation analysis.*
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 to 600 joules (J)) found in Table 10 in Crocker and Fratantonio (2016), which reports a 203 dB_{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 5 m depth assuming an omnidirectional beam width was considered as a proxy or comparison to the Dura-Spark 240. The corresponding 203 dB_{RMS} level is considered a realistic and conservative value that aligns with the history of operations of the Dura-Spark 240 over 3 years of surveys by Atlantic Shores.

Operational information was provided by Atlantic Shores and assumes that the Geo Marine Survey System would be operating at 400 J.
b – Information on the source level was obtained from Gene Andella (Edgetech) with JASCO Applied Sciences.
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.
e – Values from Crocker and Fratantonio (2016) for 100% power and comparable bandwidth.
f – For a frequency of 4 kHz.
g – Parametric sub-bottom profilers do not have the potential to harass marine mammals due to their lower frequencies and extremely narrow beamwidth (see 87 FR 24103, April 22, 2022). Therefore, these sources were not considered in calculating the maximum r value for the ensonified area calculation.
h – The specification sheet indicates a peak source level of 247 dB re 1 μPa m (based on personal communications with Atlantic Shores to Jens Wunderlich, Innomar, 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. Atlantic Shores therefore estimates the SPL source level is 241 dB re 1 μPa m.

The CHIRPs and sparkers operate at a frequency that is detectable by the ESA listed whales, sea turtles, and Atlantic sturgeon in the action area. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

7.1.3 Effects of Project Noise on ESA-Listed Whales

Background Information – Acoustics and Whales

The *Federal Register* notice prepared for the Proposed ITA (88 FR 65430; September 22, 2023) presents extensive information on the potential effects of underwater sound on marine mammals. Rather than repeat that information, that information is incorporated by reference here. As explained in detail in the *Federal Register* notice, anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe behavioral responses, depending on received levels, duration of exposure, behavioral context, and various other factors. Underwater sound from active acoustic sources can have one or more of the following effects: temporary or permanent hearing impairment, non-auditory physical or physiological effects (including injury), behavioral disturbance, stress, and masking (Richardson et al., 1995; Gordon et al., 2004; Nowacek et al., 2007; Southall et al., 2007; Götz et al., 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing (i.e. temporary (TTS) or permanent threshold shift (PTS) respectively) will occur almost exclusively for noise within an animal's hearing range.

Richardson et al. (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking may occur. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (e.g., snapping shrimp, wind, waves, precipitation) or anthropogenic (e.g., shipping, sonar, seismic exploration) in origin. Masking is when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold. The masking zone may be highly variable in size. Masking can lead to behavioral changes in an attempt to compensate for noise levels or because sounds that would typically have triggered a behavior were not detected.

In general, the expected responses to pile driving noise may include threshold shift, behavioral effects, stress response, and auditory masking. Threshold shift is the loss of hearing sensitivity at certain frequency ranges (Finneran 2015). It can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall et al., 2007). PTS is an auditory injury, which may vary in degree from minor to significant. Behavioral disturbance may include a variety of effects, including subtle changes in behavior (e.g., minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Not all behavioral disturbance would have meaningful consequences to an individual. The duration of the disturbance and the activity that is impacted are considered when evaluating the potential for a behavioral disturbance to significantly disrupt normal behavioral patterns. An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (e.g., Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical response in terms of energetic costs is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Matthews and Parks (2021) summarizes the documented acoustic signals, hearing capabilities, and responses to sound of North Atlantic right whales. Comparison of acoustic data from recordings of right whales over time demonstrates changes in vocalizations that are thought to be a result of changing acoustic environment. With higher noise levels, individuals shift their vocalizations to call at a higher frequency and increased duration. Observations of right whale behavior around vessels indicates that when a vessel is passing, they often will move away slowly, and, if a vessel approaches, they will dive quickly. It is unknown if right whales are responding to vessel noise or the presence of the vessel itself (numerous sources cited in Matthews and Parks 2021).

Criteria Used for Assessing Effects of Noise Exposure to Fin, Right, Sei, and Sperm Whales
NMFS *Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* compiles, interprets, and synthesizes scientific literature to produce updated acoustic thresholds to assess how anthropogenic, or human-caused, sound affects the hearing of

all marine mammals under NMFS jurisdiction (NMFS 2018[39]). Specifically, it identifies the received levels, or thresholds, at which individual marine mammals are predicted to experience temporary or permanent changes in their hearing sensitivity for acute, incidental exposure to underwater anthropogenic sound sources. As explained in the document, these thresholds represent the best available scientific information. These acoustic thresholds cover the onset of both temporary (TTS) and permanent hearing threshold shifts (PTS). We consider the NMFS technical guidance the best scientific information available for assessing the effects of anthropogenic noise on marine mammals.

Table 7.1.6. Impulsive acoustic thresholds identifying the onset of permanent threshold shift and temporary threshold shift for the marine mammal species groups considered in this opinion (NMFS 2018)

Hearing Group	Generalized Hearing Range[40]	Permanent Threshold Shift Onset[41]	Temporary Threshold Shift Onset
Low-Frequency Cetaceans (LF: baleen whales –fin, right, sei)	7 Hz to 35 kHz	*L*pk,flat: 219 dB *L*E,LF,24h: 183 dB	*L*pk,flat: 213 dB *L*E,LF,24h: 168 dB
Mid-Frequency Cetaceans (MF: sperm whales)	150 Hz to 160 kHz	*L*pk,flat: 230 dB *L*E,MF,24h: 185 dB	*L*pk,flat: 224 dB *L*E,MF,24h: 170 dB

Note: Peak sound pressure level (Lp,0-pk) has a reference value of 1 µPa, and weighted cumulative sound exposure level (LE,p) has a reference value of 1µPa2 s. In this Table, thresholds are abbreviated to be more reflective of International Organization for Standardization standards (ISO 2017). The subscript "flat" is being included to indicate peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kHz). The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans) and that the recommended accumulation period is 24 hours. The weighted cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle).

These thresholds are a dual metric for impulsive sounds, with one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that does incorporate exposure duration. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, The cumulative sound exposure criteria incorporate auditory weighting

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[39] See www.nmfs.noaa.gov/pr/acoustics/guidelines.htm for more information.

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

[41] *L*pk,flat: unweighted ($_{flat}$) peak sound pressure level (L_{pk}) with a reference value of 1 µPa; *L*E,$_{XF,24h}$: weighted (by species group; $_{LF}$: Low Frequency, or $_{MF}$: Mid-Frequency) cumulative sound exposure level (L_E) with a reference value of 1 µPa^2-s and a recommended accumulation period of 24 hours ($_{24h}$)

functions, which estimate a species group's hearing sensitivity, and thus susceptibility to TTS and PTS, over the exposed frequency range, whereas peak sound exposure level criteria do not incorporate any frequency dependent auditory weighting functions.

In using these thresholds to estimate the number of individuals that may experience auditory effects in the context of the MMPA, NMFS classifies any exposure equal to or above the threshold for the onset of PTS as auditory injury (and thus MMPA Level A harassment). As defined under the MMPA, Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. NMFS considers exposure to impulsive noise greater than 160 dB re 1uPa rms to result in MMPA Level B harassment. As defined under the MMPA, Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. As defined in the MMPA, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild. Among Level B exposures, NMFS OPR does not distinguish between those individuals that are expected to experience TTS and those that would only exhibit a behavioral response. The 160 dB re 1uPa rms threshold is based on observations of behavioral responses of mysticetes (Malme et al. 1983; Malme et al. 1984; Richardson et al. 1986; Richardson et al. 1990), but is used for all marine mammal species.

As explained below, given the differences in the definitions of "harassment" under the MMPA and ESA, it is possible that some activities could result in harassment, as defined under the MMPA, but not meet the definition of harassment used by NMFS to determine whether ESA harassment is likely to occur. Under the ESA, take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering." NMFS does not have a regulatory definition of "harass." However, on December 21, 2016, NMFS issued interim guidance[42] on the term "harass," under the ESA, defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." The NMFS interim ESA definition of "harass" is not equivalent to MMPA Level B harassment. Due to the differences in the definition of "harass" under the MMPA and ESA, there may be activities that result in effects to a marine mammal that would meet the threshold for both MMPA Level B harassment and harassment under the ESA, while other activities may result in effects that would meet the threshold for Level B harassment under the MMPA but not harassment (i.e. as defined in NMFS Policy Directive 02-110-19) under the ESA. This issue is addressed further in the sections that follow.

For this consultation, we considered NMFS' interim guidance on the term "harass" under the ESA when evaluating whether the proposed activities are likely to harass ESA-listed species, and

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[42] NMFS Policy Directive 02-110-19; available at *https://media.fisheries.noaa.gov/dam-migration/02-110-19.pdf*; last accessed November 15, 2023.

we considered the available scientific evidence to determine the likely nature of the behavioral responses and their potential fitness consequences.

7.1.3.1 Effects of Project Noise on ESA-Listed Whales

Fin, sei, sperm, and right whales may be exposed to increased underwater noise from a variety of sources during construction, operation, and/or decommissioning of the Atlantic Shores project. As explained in section 3, NMFS OPR is proposing to authorize MMPA Level B harassment take of a number of fin, sei, sperm, and right whales as a result of exposure to noise from foundation pile driving, vibratory pile driving for cofferdam installation/removal, and HRG surveys and to authorize MMPA Level A take of a small number of fin and sei whales as a result of exposure to noise from foundation pile driving. Atlantic Shores did not request authorization for MMPA take of ESA listed marine mammal species for any other noise sources, and OPR is not proposing to authorize MMPA take of any ESA listed whale species for any noise sources other than pile driving and HRG surveys. No serious injury or mortality is expected to result from exposure to any project noise sources and none is proposed to be authorized through the MMPA ITA. As described below, NMFS GARFO has carried out our own independent analysis of these noise sources in the context of the ESA definition of take.

Here, we consider the effects of exposure and response to underwater noise during construction, operations, and decommissioning in the context of the ESA. Information on the relevant acoustic thresholds and a summary of the best available information on likely responses of whales to underwater noise is presented above.

Pile Driving for WTG, OSS, and Met Tower Foundations

In their ITA application and supplemental information, Atlantic Shores estimated exposure of marine mammals (including ESA listed fin, right, sei, and sperm whales) known to occur in the lease area and along the cable corridors to a number of noise sources above the MMPA Level A and Level B harassment thresholds. As part of the response to the MMPA ITA application, OPR conducted their own review of the model reports and determined they were based on the best available information. OPR relied on the model results to develop the proposed ITA.

For the purposes of this ESA section 7 consultation, we evaluated the applicants' and OPR's exposure estimates of the number of ESA-listed marine mammals that would be "taken" relative to the definition of MMPA Level A and Level B harassment and considered this expected MMPA take in light of the ESA definition of take including the NMFS definition of harm (64 FR 60727; November 8, 1999) and NMFS interim guidance on the definition of harass (see NMFS policy directive 02-110-19[43]). We have independently evaluated and adopted OPR's analysis of the number of fin, right, sei, and sperm whales expected to be exposed to pile driving noise because, after our independent review we determined it utilized the best available information and methods to evaluate exposure of these whale species to such noise. BOEM's BA is consistent with the analysis and exposure estimates presented in the Notice of Proposed ITA with the exception of the modifications to the amount of Level A and Level B take due to the updates made between the time the BA was issued to the time the proposed rule was published. Below we describe Atlantic Shores and NMFS OPR's exposure analyses for these species.

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[43] Available at: https://www.fisheries.noaa.gov/s3/2023-05/02-110-19-renewal-kdr.pdf
Last accessed December 2, 2023.

Acoustic Modeling
The Notice of Proposed ITA and BOEM's BA provide extensive information on the acoustic modeling prepared for the project (Weirathmueller et al. 2023; COP Appendix II-L); this was supplemented by a June 2023 memo considering the revised PDE (WTG foundations installed during the first year of the buildout will all be monopile foundations, WTG foundations installed during the second year of the buildout could be either monopile or jacket foundations; JASCO 2023). That information is summarized here. As addressed above, BOEM and NMFS OPR will require use of a noise abatement system to achieve 10 dB noise attenuation; thus, modeling and exposure estimates incorporated 10 dB noise attenuation. Effectively achieving 10 dB noise attenuation is thus a critical element of modeling and this Opinion's effects analysis predicting exposure and the resultant number and type of take for each listed whale species.

To estimate take from foundation installation activities, Atlantic Shores assumed the buildout described for the modified Schedule 2 (see the PDE Refinement Memo), that is, all WTGs and the Met Tower for Project 1 would be built using 15-m monopiles and all OSSs and all WTGs for Project 2 would be built on jacket foundations using 5-m piles. The anticipated pile driving schedule (days per month) for the full buildout of Atlantic Shores South (200 WTGs) assuming Schedule 2 is presented in Table 16 of the proposed MMPA ITA (Table 7.1.7 below). Atlantic Shores has requested NMFS OPR issue two distinct LOAs for each of Project 1 and Project 2. As such, in the proposed rule, OPR also estimates the maximum amount of annual take from each Project which, collectively, is greater than the maximum considering the total foundations in the PDE given it is currently unknown exactly how many WTG and OSSs will be constructed in each Project (i.e., while 200 WTG foundations will be installed, there is uncertainty about the exact number per project). For the take analysis in the MMPA ITA, it was assumed that Project 1 would have a maximum of 105 WTGs (plus 6 WTG foundations installed as part of the Overlap Area for Project 1; n=111), 1 Met Tower, and 2 OSSs and Project 2 would have a maximum of 89 WTGs (plus 6 WTG foundations installed as part of the Overlap Area for Project 2; n=95) and 2 OSS. Between these schedules, we note that Atlantic Shores has analyzed the construction of 205 permanent foundation structures, including up to 200 WTGs, one Met Tower, and 4 large-sized OSSs. The 6 WTGs in the overlap area are included in the maximum take calculation for each of Project 1 and Project 2. The Project 1 take calculations include the 6 WTGs in the overlap area during Year 1 to ensure sufficient take for Project 1 (if those positions are allocated to Project 1 during construction). If, however, those positions are allocated to Project 2, they are also included during Year 1 of foundation installation for Project 2 (to ensure sufficient take allocation to Project 2 during that year). However, the full buildout scenario, which describes the take for the Projects combined, only includes the 6 WTGs in the entire project once (to avoid double counting of the 6 WTGs). For the exposure calculation, the modeling assumes installation of 1 monopile or 4 pin piles per day as this represents the maximum number of pile driving days. We recognize that the number of pile driving days could be reduced if two monopiles are installed on some days or if further project refinements result in a reduction in the total number of foundations to be installed.

Table 7.1.7 – Project 1 and Project 2’s Buildout Schedule Presented Annually and Over Two-Years

Construction Month	Year 1 (2026)							Year 2 (2027)[a]	
	Project 1		Project 2		Total			Project 2	
	Number of Days (Number of piles installed)		Number of Days (Number of piles installed)					Number of Days (Number of piles installed)	
	WTG and Met Tower Monopile 15-m (1 pile/day)	OSS Jacket 5-m Pin Piles (4 piles/day)	WTG Jacket 5-m Pin Piles (4 piles/day)	OSS Jacket 5-m Pin Piles (4 piles/day)	WTG Monopile 15-m (1 pile/day)	WTG Jacket 5-m Pin Piles (4 piles/day	OSS Jacket 5-m Pin Piles (4 piles/day)	WTG Jacket 5-m Pin Piles (4 piles/day)	OSS Jacket 5-m Pin Piles (4 piles/day)
May	8 (8)	0 (0)	0 (0)	0 (0)	8 (8)	0 (0)	0 (0)	5 (20)	0 (0)
June	20 (20)	6 (24)	0 (0)	0 (0)	20 (20)	0 (0)	6 (24)	15 (60)	6 (2$)
July	25 (25)	0 (0)	0 (0)	0 (0)	25 (25)	0 (0)	0 (0)	20 (80)	0 (0)
August	19 (19)	6 (24)	0 (0)	0 (0)	19 (19)	0 (0)	6 (24)	18 (72)	6 (2$)
September	18 (18)	0 (0)	0 (0)	0 (0)	18 (18)	0 (0)	0 (0)	14 (56)	0 (0)
October	16 (16)	0 (0)	0 (0)	0 (0)	16 (16)	0 (0)	0 (0)	13 (52)	0 (0)
November	5 (5)	0 (0)	5 (20)	0 (0)	5 (5)	5 (20)	0 (0)	4 (16)	0 (0)
December	1 (1)	0 (0)	1 (4)	0 (0)	1 (1)	1 (4)	0 (0)	0 (0)	0 (0)

Totals						
Total Piling Days	112	12	6	112	18	101
Total Piles	112	48	24	112	72	404
Total Foundations [b]	112	2	6	112	8	91

a – As 2027 only has foundation installation activities occurring from Project 2, there is no total column for this year.
b – The total foundations included in this table sum up to more (n=207) than the planned number of WTG and Met Tower foundations (n=201) due to the possibility of 6 WTGs being installed either under Project 1 or Project 2 in the Overlap Area; these are therefore counted twice within this table.
(source: Table 16 in MMPA ITA)

As noted above, the updated acoustic thresholds for impulsive sounds (such as impact pile driving) contained in the Technical Guidance (NMFS, 2018) are dual metric acoustic thresholds using both SEL_{cum} and peak sound pressure level metrics (Table 7.1.11). As dual metrics, NMFS considers onset of PTS (MMPA Level A harassment) to have occurred when either one of the two metrics is exceeded. The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group. For example, the distance from the source to the peak Level A threshold marks the outer bound of the area within which an animal needs to be located in order to be exposed to enough noise to experience Level A harassment from a single pile strike. Considering acoustic range, the distance from the source to the cumulative Level A threshold marks the outer bound of the area within which an animal needs to stay for the entire duration of the activity considered (e.g., the entire 7 to 9 hours of pile driving to install a monopile).

To estimate the probability of exposure of animals to sound above NMFS' harassment thresholds during foundation installation, JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) was used to integrate the sound fields generated from the source and propagation models described above (considering the identified amount of sound attenuation) with species-typical behavioral parameters (*e.g.*, dive patterns). Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3-D sound fields with movement rules derived from animal observations. Animats that exceed NMFS' acoustic thresholds are identified and the range for the exceedances determined. The output of the simulation is the exposure history for each animat within the simulation. An individual animat's sound exposure levels are summed over a specific duration (24 hours, considering the maximum amount of pile driving proposed for a 24-hour period for each pile type modeled), to determine its total received acoustic energy (SEL) and maximum received PK and SPL. For modeling of monopiles, this included up to 2 monopiles per 24 hour period; for jackets, up to 4 pin piles per 24 hour period. These received levels are then compared to the threshold criteria within each analysis period. The combined history of all animats gives a probability density function of exposure during the project. The number of animals expected to exceed the regulatory thresholds is determined by scaling the number of predicted animat exposures by the species-specific density of animals in the area. By programming animats to behave like marine species that may be present near the Lease Area, the sound fields are sampled in a manner similar to that expected for real animals. The parameters used for forecasting realistic behaviors (*e.g.*, diving, foraging, and surface times) were determined and interpreted from marine species studies (*e.g.*, tagging studies) where available, or reasonably extrapolated from related species (Weirathmueller et al. 2023). Note that animal aversion was not incorporated into the JASMINE model runs that were the basis for the take estimate for any species; that is, the models do not incorporate any animal movements or avoidance behavior that would be expected to result from exposure to underwater noise. The modeling also does not incorporate the clearance or shutdown requirements.

As described in JASCO's acoustic modeling report for Atlantic Shores (Weirathmueller et al. 2023), for modeled animals that have received enough acoustic energy to exceed a given harassment threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. OPR used exposure ranges in the context of estimating exposure to noise above the cumulative Level A harassment threshold. The CPA for each of the species-specific animats during a simulation is recorded and then the CPA distance that accounts for 95 percent of the animats that exceed an acoustic impact threshold is determined. The $ER_{95\%}$ (95 percent exposure radial distance) is the horizontal distance that includes 95 percent of the CPAs of animats exceeding a given impact threshold. The $ER_{95\%}$ ranges are species-specific rather than categorized only by any functional hearing group, which allows for the incorporation of more species-specific biological parameters (*e.g.*, dive durations, swim speeds, etc.) for assessing the impact ranges into the model.

Atlantic Shores calculated acoustic ranges which represent the distance to a harassment threshold based on sound propagation through the environment (*i.e.*, independent of any receiver). As described in the proposed MMPA ITA, NMFS OPR considers acoustic ranges ($R_{95\%}$) to the Level A harassment SELcum metric thresholds overly conservative as the accumulation of acoustic energy does not account for animal movement and behavior and therefore assumes that animals are essentially stationary at that distance for the entire duration of the pile installation, a scenario that does not reflect realistic animal behavior. Because NMFS Level A peak and Level B harassment thresholds are an instantaneous exposure, acoustic ranges are reasonable to use in that context.

In the proposed MMPA ITA, NMFS OPR considers exposure ranges to Level A harassment (SEL) and acoustic ranges to Level A peak and Level B harassment thresholds, densities, exposure estimates and the amount of take requested and proposed to be authorized incidental to foundation installation in consideration of the parameters outlined here. The proposed MMPA ITA analyzes a construction schedule that includes a full monopile WTG build-out of Project 1 plus the Met Tower and a full jacket buildout for the WTGs in Project 2 with pile driving occurring over two construction seasons (May through December, annually). The MMPA ITA recognizes that, as an alternative, Atlantic Shores may install all monopile foundations for Project 1 and Project 2. However, Atlantic Shores take request, and NMFS OPR's proposed authorization considers the monopile and jacket foundation option (referred to as Construction Schedule 2) as they determined it has the potential to result in exposure of a greater number of animals to noise above the thresholds of concern compared to schedule 1 (all monopiles). We do not have the information necessary to present exposure or take estimates for an all monopile scenario for marine mammals; thus, this Opinion considers the effects of installation of monopiles for Project 1 and jacket foundations for Project 2.

We also note that the proposed MMPA ITA provided the modeled exposure and ranges for 12 m and 15 m monopiles and as explained in the proposed MMPA ITA, the 15-m monopiles produce larger sound fields in general; therefore, NMFS OPR is proposing to authorize an amount of take that reflects installation of all 15 m monopiles. Similarly, as explained in the proposed MMPA ITA, because post-piled pin piles produce larger sound fields than pre-piled piles, the proposed rule carries forward take specific to the post-piled pin piles. With these considerations, we consider for the purposes of this Opinion, that the resulting estimates of exposure of ESA listed marine mammals to noise above the Level A and Level B harassment thresholds represents a reasonable upper limit of exposure during the project that is unlikely to be exceeded, absent any consideration of the potential for the proposed minimization measures (i.e., clearance and shutdown requirements) to reduce actual exposure (which is addressed below).

Exposure ranges (ER95%) for impact pile driving of a 12-m monopile, 15-m monopile, and 5-m pin pile and (pre- and post-piled) jacket foundations, assuming 10 dB of sound attenuation to the PTS (SEL) thresholds are presented in the table below.

Table 7.1.8 – Exposure Ranges ($ER_{95\%}$) in Kilometers to Marine Mammal PTS (SEL; Level A Harassment) Thresholds During Impact Pile Driving 12-m and 15-m Monopiles, and 5-m Pin Piles (Pre- and Post-piled) For Jackets, Assuming 10 dB Attenuation

Marine Mammal Hearing Group and Species	12-m Monopiles, 4,400 kJ hammer		15-m Monopiles, 4,400 kJ hammer		5-m Pin Piles, 2,500 kJ hammer	
	One pile/day	Two piles/day[b]	One pile/day	Two piles/day[b]	Four pin piles/day (pre-piled)	Four pin piles/day (post-piled)
North Atlantic right whale (migrating)	0.56	0.67	0.72	0.72	0.73	1.06
Fin whale (sei whale proxy)[a]	1.09	1.30	1.81	1.83	1.80	1.90
Sperm whale*	0	0	0	0	0	0

a – Given their similarities, fin whales were used as a surrogate for sei whale behaviors.
b – Given the revised construction schedule, Atlantic Shores has carried forward into their exposure and take estimates only constructing one pile per day for this proposed action.
source: Table 13 in Proposed MMPA ITA

As described above, Atlantic Shores also calculated acoustic ranges which represent distances to identified thresholds independent of movement of a receiver. Presented below are the distances to the PTS (dB peak) threshold for impact pile driving and the Level B harassment (SPL) thresholds for all impact pile driving during WTG, OSS, and Met Tower foundation installation.

Table 7.1.9 – Acoustic Ranges ($R_{95\%}$), in Kilometers, to PTS (L_{pk}) Thresholds During Impact Pile Driving, Assuming 10 dB Attenuation

Pile Type	Modeled Source Location	Hammer Energy (kJ)	Low-frequency cetacean	Mid-frequency cetacean
			219 $L_{p, pk}$	230 $L_{p, pk}$
12-m Monopile	L01	4,400	0.08	0.01
	L02	4,400	0.06	0.01
15-m Monopile	L01	4,400	0.08	0.01
	L02	4,400	0.07	0.01
5-m Pin Pile	L01	2,500	0.02	0.00

	L02	2,500	0.02	0.00
5-m Pin Pile (2 dB shift for post-piled)	L01	2,500	0.01	0.00
	L02	2,500	0.01	0.01

Note: $L_{p,pk}$ = peak sound pressure (dB re 1 μPa)
source: Table 14 in Proposed MMPA ITA

Table 7.1.10 – Flat Acoustic Ranges (Flat $R_{95\%}$), in Kilometers, to Level B Harassment (SPL, 160 L_P) Thresholds During Impact Pile Driving, Assuming 10 dB Attenuation

Pile Type	Hammer Energy (kJ)	L01	L02
12-m Monopile	4,400	4.26	3.91
15-m Monopile	4,400	4.31	4.00
5-m Pin Pile (pre-piled)	2,500	2.47	0.63
5-m Pin Pile (post-piled)	2,500	2.81	0.81

Note: L_p = root-mean square sound pressure (dB re 1 μPa)
source: Table 15 in Proposed MMPA ITA, as corrected by NMFS OPR in November 2023

Atlantic Shores modeled density-based estimates of animals exposed to noise above Level A harassment and Level B harassment for the identified construction scenario. As explained in the proposed MMPA ITA, for monopile and jacket foundation installation, mean monthly densities for all species were calculated by first selecting density data from 5 x 5 km (3.1 x 3.1 mile) grid cells (Roberts *et al.*, 2016; Roberts et al. 2023) both within the Lease Area and outside the lease area to include a buffer based on the largest 10-dB attenuated exposure range calculated for the largest piles. This resulted in density estimates considering all grid cells within the lease area plus a 3.9 km buffer around the lease.

Table 7.1.11 – Mean Monthly and Annual Marine Mammal Density Estimates (Animals/100 km^2) for Impact Pile Driving for the pile driving window (May 1 – December 31)

Marine Mammal Species	May	Jun	July	Aug	Sep	Oct	Nov	Dec	May-Dec Mean
North Atlantic right whale	0.010	0.003	0.001	0.001	0.002	0.004	0.010	0.042	0.009
Fin whale	0.088	0.075	0.047	0.028	0.029	0.031	0.038	0.141	0.060
Sei whale	0.027	0.006	0.001	0.001	0.002	0.008	0.026	0.042	0.014
Sperm whale	0.010	0.005	0.003	0.000	0.000	0.000	0.003	0.004	0.003

a – Density estimates are calculated from the 2022 Duke Habitat-Based Marine Mammal Density Models (Roberts et al., 2016; Roberts et al., 2023).

To estimate the amount of take that may occur incidental to the foundation installation, Atlantic Shores conducted exposure modeling to estimate the number of exposures that may occur from impact pile driving in a 24-hour period. Exposure estimates were then scaled to reflect the density estimates described above (Table 7.1.11). These scaled 24-hour exposure estimates were then multiplied by the number of days of pile driving to produce the estimated take numbers for each year. In some cases, exposure estimates were subsequently adjusted based on group sizes (i.e., the number of individuals that are typically documented together for a species, see Table 7.1.12).

Table 7.1.12 Mean Group Sizes of ESA Listed Species (considered in the proposed MMPA ITA) from the OBIS data repository (OBIS, 2022)

Marine Mammal Species	Mean Group Size
Fin whale	1.3
North Atlantic right whale	3.8
Sei whale	2.1
Sperm whale	1.8

source: Table 12 in the proposed MMPA ITA

For example, the model predicts exposure of 1.24 right whales to noise above the level B harassment threshold in construction year 1; this is adjusted to 4 to account for the average group size of 3.8 right whales. Additionally, while the model did not predict any exposure of sperm whales to noise above the level B harassment threshold (due to the very low density), Atlantic Shores requested, and NMFS OPR proposes to authorize, the take of 2 sperm whales to account for their documented presence in the project area and the documented mean group size of 1.8. The total exposure estimates, by species, for each of the two construction seasons, and the proposed amount of take (which considers the group size adjustments, and for level A take of right whales only, consideration of proposed mitigation measures) is presented in Table 7.1.13 and 7.1.14 below. The total amount of proposed take for impact pile driving of foundations is summarized in Table 7.1.15.

Table 7.1.13 – Annual Total Exposure Estimates and Proposed Takes by Level A Harassment and Level B Harassment for Foundation Installation Activities for Project 1 (All Monopile foundations)

Marine Mammal Species	Construction Year 1 (est. 2026)			
	Estimated Exposures		Proposed Take	
	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment
North Atlantic right whale	0.14	1.24	0	4
Fin whale	2.80	8.23	3	9
Sei whale	0.35	1.04	1	3
Sperm whale	0	0	0	2

a – While the foundation installation counted the 6 WTGs in the Overlap Area for both Project 1 and Project 2, the exposure estimates and take requested is based on those 6 WTGs only being installed once under the full buildout scenario; no double counting of take occurred.
b – All of Project 1's activities would be completed within a single year (2026), which means that no take would occur during the second construction year (2027).
source: Table 17 in Proposed MMPA ITA

Table 7.1.14 – Annual Exposure Estimates and Proposed Takes by Level A Harassment and Level B Harassment for Foundation Installation Activities For Project 2, All Jacket Foundations[a]

Marine Mammal Species	Construction Year 1 (2026)				Construction Year 2 (2027)			
	Estimated Exposures		Proposed Take		Estimated Exposures		Proposed Take	
	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment
North Atlantic right whale	0.08	0.43	0	4	0.24	1.31	0	4
Fin whale	0.24	0.65	1	2	3.46	9.20	4	10
Sei whale	0.13	0.34	1	3	0.41	1.09	1	3
Sperm whale	0	0	0	2	0	0	0	2

a – Includes the 6 WTGs in the Overlap Area.
Source: Table 18 in the Proposed MMPA ITA

NMFS OPR proposes to authorize the following numbers for the harassment of marine mammals incidental to foundation installation activities of WTGs, OSSs, and the Met Tower by Level A harassment and Level B harassment in Table 7.1.15. We note that Atlantic Shores did not request, nor is NMFS proposing to authorize, serious injury and/or mortality of marine mammals. No Level A harassment of North Atlantic right whales has been proposed for authorization by NMFS OPR due to enhanced mitigation measures that Atlantic Shores would be required to implement for this species.

Table 7.1.15 –Proposed Takes by Level A Harassment and Level B Harassment for All Foundation Installation Activities in Both Project 1 and Project 2[a]

Marine Mammal Species	Construction Year 1		Construction Year 2		Total	
	Proposed Take		Proposed Take		Proposed Take	
	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment
North Atlantic right whale	0	8	0	4	0	12
Fin whale	3	11	4	10	7	21
Sei whale	2	6	1	3	2	9
Sperm whale	0	4	0	2	0	6

a – While the foundation installation counted the 6 WTGs in the Overlap Area for both Project 1 and Project 2, the exposure estimates and take requested is based on those 6 WTGs only being installed once under the full buildout scenario; no double counting of take occurred. In total, this table accounts for exposure and take estimates of 200 WTGs, 1 Met Tower, and 4 OSSs.
Source: Table 19 in the Proposed MMPA ITA

We note that Atlantic Shores requested and NMFS proposes to authorize, the full amount of Level A take of fin and sei whales predicted by the exposure modeling (rounded up to whole animals). However, due to the enhanced mitigation measures for North Atlantic right whales, no Level A harassment takes were requested for this species nor is NMFS OPR proposing to authorize any. Our consideration of this assessment is presented below.

7.1.3.1 Consideration of Proposed Measures to Minimize Exposure of ESA Listed Whales to Pile Driving Noise

Here, we consider the measures that are part of the overall proposed action, either because they are proposed by Atlantic Shores in the COP, by BOEM as described in the BA regarding potential COP approval conditions, or by NMFS OPR as requirements of the proposed ITA. We also consider how those measures may serve to minimize exposure of ESA listed whales to pile driving noise. Details of these proposed measures are included in section 3 above.

Seasonal Restriction on Impact Pile Driving of Foundations

No impact pile driving activities would occur between January 1 and April 30 to avoid the time of year with the highest densities of right whales in the WDA. This seasonal restriction is factored into the acoustic modeling that supported the development of the amount of take proposed in the ITA. That is, the modeling does not consider any impact pile driving in the

January 1 – April 30 period. Thus, the take estimates do not need to be adjusted to account for this seasonal restriction.

Sound Attenuation Devices and Sound Field Verification

For all impact pile driving, Atlantic Shores would implement sound attenuation technology that would achieve at least a 10 dB reduction in pile driving noise; BOEM is requiring that the noise mitigation device(s) perform such that measured ranges to the Level A and Level B harassment thresholds are consistent with (i.e., no larger than) those modeled assuming 10 dB attenuation, determined via sound source verification (see Tables 7.1.8, 7.1.9, and 7.1.10; noting that we anticipate for distances determined via exposure ranges, the corresponding acoustic ranges will be used for SFV comparison). This requirement is also proposed in the MMPA ITA. Together, the purpose of the requirements to utilize sound attenuation devices (also referred to as noise or sound mitigation measures) and sound field verification (i.e., in situ noise monitoring during pile driving) are to ensure that Atlantic Shores does not exceed the modeled distances to the Level A and Level B harassment thresholds for ESA listed marine mammals (modeled assuming 10 dB attenuation). The sound field verification related measures are based on the expectation that Atlantic Shores' initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation) but, if that is not the case, provide a step-wise approach for modifying or adding sound attenuation measures that can reasonably be expected to achieve those metrics prior to the next pile being driven.

The 10 dB attenuation was incorporated into the take estimate calculations presented above. Thus, the take estimates do not need to be adjusted to account for the use of sound attenuation. If a reduction greater than 10 dB is achieved, the actual amount or extent of take could be lower as a result of resulting smaller distances to thresholds of concern. In section 7.1.2, we provided an explanation for why it is reasonable to expect that 10 dB of sound attenuation for impact pile driving can be achieved assuming proper deployment and maintenance of devices, with the most recent information indicating that proper deployment and continuous maintenance of a dBBC plus a nearfield attenuation device provides the highest likelihood of consistent success (i.e. SFV reports for the South Fork and Vineyard Wind 1 projects). This is consistent with the requirements of the proposed MMPA ITA.

Through conditions of the proposed ITA and conditions of the proposed COP approval, Atlantic Shores will conduct sound field verification (SFV) for at least the first three monopiles and the first three full jacket foundations (inclusive of all pin piles for the foundation). Atlantic Shores is also required to conduct sound field verification of any additional piles in locations that are not represented by the previous locations where sound field verification was carried out or where pile specifications are different (e.g., 12 m vs. 15 m diameter monopiles, higher hammer energy, greater number of strikes). As required by the proposed MMPA ITA, SFV measurements must continue until at least three consecutive monopiles and three entire jacket foundations demonstrate noise levels are at or below those modeled, assuming 10 dB of attenuation. Additional details of the required sound field verification are included in the proposed MMPA ITA.

The required sound field verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. As described in the proposed MMPA ITA, if sound field verification measurements on any of the first three piles of each pile type indicate that the ranges to Level A harassment or Level B harassment isopleths are larger than those modeled, assuming 10-dB attenuation, Atlantic Shores must modify and/or apply additional noise attenuation measures (e.g., improve efficiency of bubble curtain(s), modify the piling schedule to reduce the source sound, install an additional noise attenuation device) before the next pile is installed. Until sound field verification confirms the ranges to Level A harassment and Level B harassment isopleths are less than or equal to those modeled, assuming 10-dB attenuation, the shutdown and clearance zones must be expanded to match the ranges to the Level A harassment and Level B harassment isopleths based on the sound field verification measurements. If the application/use of additional and/or modified noise attenuation measures still does not achieve ranges less than or equal to those modeled, assuming 10-dB attenuation, and no other actions can further reduce sound levels, Atlantic Shores must expand the clearance and shutdown zones according to those identified through sound field verification, in coordination with NMFS OPR. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than or equal to those modeled, this may indicate that the amount or extent of taking specified in the incidental take statement has been exceeded or be considered new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation is expected to be necessary. (50 CFR 402.16).

Clearance and Shutdown Zones

As described in Section 3, Atlantic Shores proposed as part of the COP and BOEM and NMFS OPR are proposing to require monitoring of clearance and shutdown zones before and during impact pile driving (also, Table 7.1.16). In addition to the clearance and shutdown zones, OPR will include a requirements for a minimum visibility distance before foundation pile driving can begin (1,900 m). This is the distance from each of the observation platforms that the visual observers must be able to effectively monitor for marine mammals; that is, lighting, weather (e.g., rain, fog, etc.), and sea state must be sufficient for the observer to be able to detect a marine mammal within that distance from the observation platform. The identified minimum visibility zone is the same size as the shutdown zone for large whales (other than right whales, which extends to any distance a right whale is observed) and is smaller than the clearance zone for fin, sei, and sperm whales (2,300 m, the right whale clearance zone extends to any distance a right whale is observed); however, when considering that there will be PSOs at the pile driving platform and on at least two dedicated PSO vessels and that the minimum visibility must be achieved at all platforms, it is reasonable to expect that the full extent of the clearance zone will be able to be visually monitored when the minimum visibility requirement is met. For example, considering the 1,900 m minimum visibility distance and considering that there will be observers at the pile driving platform and then at a vessel located at a distance from the pile that would maximize detections of animals in the clearance and shutdown zones, we would expect visual monitoring extending from the pile out to at least 3.8 km (i.e., 1,900 m from the pile driving platform plus an additional 1,900 m from a vessel located approximately 2 km from the pile); this is larger than the 2.3 km clearance zone. Further, we note that the proposed MMPA ITA and BOEM’s proposed conditions require that the full extent of identified clearance zones be able to be effectively monitored and not obscured by fog, rain, etc. before clearance procedures begin.

The clearance zone is the area around the pile that must be declared “clear” of marine mammals (and sea turtles) prior to the activity commencing. The size of the zone is measured as the radius with the impact activity (i.e., pile) at the center. For marine mammals, both visual observers and passive acoustic monitoring (PAM, which detects the sound of vocalizing marine mammals) will be used; the area is determined to be “cleared” when visual observers and PAM operators have determined there have been no sightings or detections of marine mammals in the identified area for a prescribed amount of time and, for North Atlantic right whales in particular, if no right whales have been visually observed in any area beyond the minimum visibility zone that the visual observers can see and no vocalizing right whales have been detected within 10 km of the pile via PAM monitoring. For example, if a right whale is observed at a distance of 4km from the pile, pile driving would be delayed. The PAM operator will declare an area “clear” if they do not detect the sound of vocalizing whales within the identified PAM clearance zone for the identified amount of time (2,300 m for fin, sei, and sperm whales, 10 km for right whales). The PAM monitoring system will be designed to detect vocalizing marine mammals located within 10 km of the pile. Pile driving cannot commence until all of these clearances are made. The clearance zone, as revised by OPR during the consultation period (see Table 7.1.16) is larger (by 400 to 1,700 m; for right whales, just considering just the 1,900 m minimum visibility zone) than the modeled distances to the ER95% for Level A cumulative threshold (Table 7.1.8) for all daily pile installation scenarios and significantly bigger (over 2km) than the acoustic range (R95%) to the peak Level A threshold (Table 7.1.9). The clearance zone (2,300 m) is slightly smaller than the distance to the Level B harassment threshold for pin piles and about half the distance to the Level B harassment threshold for monopiles (Table 7.1.10). We note that OPR may make additional modifications to these zone sizes in the MMPA final rule.

Once pile driving begins, the shutdown zone applies. If a marine mammal is observed by a visual PSO entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless Atlantic Shores and/or its contractor determines shutdown is not feasible due to an imminent risk of injury or loss of life to an individual; or risk of damage to a vessel that creates risk of injury or loss of life for individuals (see section 3.0 for more information). Similarly, detection of a vocalizing whale within the identified shutdown zone by the PAM operator would trigger a call for a shutdown. For right whales, shutdown is also triggered by: the visual PSO observing a right whale at any distance (i.e., even if it is outside the shutdown zone identified for other whale species), or a detection by the PAM operator of a vocalizing right whale at any distance within the 10 km distance from the pile that will be monitored by PAM. The shutdown zones, as revised by OPR during the consultation period (see Table 7.1.21) are larger than the modeled distances to the ER95% for Level A cumulative threshold (Table 7.1.8) and the acoustic range (R95%) to the peak Level A threshold (Table 7.1.9) for all pile installation scenarios. The shutdown zone (1,900 m) is smaller than the distance to the Level B harassment threshold for pin piles and about half the distance to the Level B harassment threshold for monopiles (Table 7.1.10). We note that OPR may make additional modifications to these zone sizes in the MMPA final rule.

Table 7.1.16. Proposed Clearance and Shutdown Zones for Foundation Pile Driving
These are the PAM detection, minimal visibility, clearance and shutdown zones incorporated into the proposed action; the zones for marine mammals reflect the proposed conditions of the

MMPA ITA as modified during the consultation period. Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility and clearance zones. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving; detection of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Impact pile driving for WTG, OSS, and Met Tower foundation installation: 1,900 m minimum visibility zone from each PSO platform (pile driving vessel and at least two PSO vessels), PAM monitoring out to 10,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM
Fin, sei, and sperm whale (visual and PAM monitoring)	2,300 m (visual or PAM detection)	1,900 m (visual or PAM detection)

Clearance zones will be monitored by at least three PSOs at the pile driving platform and at least three PSOs actively observing on at least two dedicated PSO vessels. All distances to the edge of clearance zones are the radius from the center of the pile. As noted above, the proposed clearance and shutdown zone is larger than the acoustic range to the Level A peak cumulative threshold (by over 2 km) and larger than the exposure range to the Level A cumulative threshold for all pile driving scenarios for all ESA listed whales (for right whales, this is the case even considering only the minimum visibility zone and not any further distance that a PSO may be able to see right whales). The PSO vessels will be located at a distance from the pile that maximizes the opportunity for effective visual observation of the clearance and shutdown zone, likely approximately 2,000 m from the pile. The PSOs would be required to maintain watch at all times when impact pile driving of foundation piles is underway. Concurrently, at least one PAM operator would be actively monitoring for marine mammals before, during, and after pile driving (more information on PAM is provided below). PSOs would visually monitor for marine mammals for a minimum of 60 minutes while PAM operators would review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, the PSO must confirm that the relevant clearance zones have been free of marine mammals for at least the 30 minutes immediately prior to starting a soft-start of pile driving. For fin, sei, and sperm whales, this means that the PSOs have not seen any individuals within the clearance zone and the PAM operator must not have detected any vocalizations from those species within the clearance zone. For right whales, this means that the PSOs have not seen any right whales in the relevant minimum visibility zone plus any additional distance that they can see beyond that minimum visibility zones. Similarly, the PAM operator must confirm that there have been no detections of vocalizing right whales within 10 km from the pile for the preceding 60 minutes. If a visual PSO observes a marine mammal entering or within the relevant clearance zone, or the PAM operator detects a right whale within the PAM clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and will not begin until either the marine mammal(s) has voluntarily left the clearance zone and has been visually or acoustically confirmed beyond that clearance zone, or, when 30 minutes have elapsed with no further sightings or acoustic detections. Pile driving must only commence when lighting, weather (e.g., rain, fog, etc.), and sea state have been sufficient for the observer to be able to detect a marine mammal within the identified clearance zones for at least 30 minutes (i.e., clearance zone is fully visible for at least 30 minutes). As required by the proposed MMPA ITA, any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a species other than a North Atlantic right whale must be treated as if it were a North Atlantic right whale.

As explained above, the requirement for the minimum visibility zones for foundation pile driving and the requirement that PSOs be working from three platforms (3 PSOs at the pile driving platform, 3 on each of two vessels at a distance from the pile), make it reasonable to expect that the full extent of the clearance zones will be effectively monitored and that large whales within this area will be detected by at least one of the PSOs. The clearance zones may only be declared clear, and pile driving started, when the full extent of all clearance zones are visible (*i.e.,* when not obscured by dark, rain, fog, etc.) for a full 30 minutes prior to pile driving and the PAM operator has made the required clearances based on detection of vocalizing whales.

Absent an approved nighttime pile driving monitoring plan, the time of day when pile driving can begin is limited to between one hour after civil sunrise and 1.5 hours before civil sunset. Impact pile driving may not be initiated any later than 1.5 hours before civil sunset and may continue after dark only when the installation of that pile began during daylight hours. Pile driving may continue after dark only when: the driving of the same pile began during the day when clearance zones were fully visible; it was anticipated that pile installation could be completed before sundown; and, pile installation must proceed for human safety or installation feasibility reasons (e.g., stopping would result in pile refusal or pile instability that would risk human life). In such cases, monitoring must be carried out consistent with an approved monitoring plan for low visibility conditions (Atlantic Shores is required to submit such a plan for review and approval by NMFS and BOEM prior to any impact pile driving). Given that the time to install the pile is expected to be predictable, we expect these instances of pile driving taking longer than anticipated to be very rare.

As described above, unless a monitoring plan is approved by BOEM, NMFS OPR, and NMFS GARFO and that plan demonstrates that PSOs working at night can observe the clearance and shutdown zones in a way that would allow for effective implementation of the clearance and shutdown zones (i.e., such that effects of pile driving would be the same at night as they were during the day), pile driving would not be initiated at night, or, when conditions prevent visual observation of the full extent of all relevant clearance zones to be confirmed to be clear of marine mammals, as determined by the lead PSO on duty. No such plans have been approved thus far and, as noted above, this effects analysis is based on the requirement that any approval of a nighttime pile driving plan will be based on the ability to effectively monitor the clearance and shutdown zones after dark. We also note that review and approval of a low visibility/alternative monitoring plan is required prior to any impact pile driving.

For impact pile driving of foundations, monitoring of the clearance zones by PSOs at the stationary platform and two PSO vessels will be supplemented by real-time passive acoustic monitoring (PAM). PAM systems are designed to detect the vocalizations of marine mammals, allowing for detection of the presence of whales underwater or outside of the range where a visual observer may be able to detect the animals. Monitoring with PAM not only allows for potential documentation of any whales exposed to noise above thresholds of concern that were not detected by the visual PSOs but also allows for greater awareness of the presence of whales in the project area as a larger area can be monitored (in this case, extending 10 km from the pile being driven). As with the monitoring data collected by the visual PSOs, this information can be used to plan the pile driving schedule to minimize pile driving at times when whales are nearby and may be at risk of exposure to pile driving noise. The PAM system will be designed and established such that calls of fin, sei, sperm, and right whales can be detected and can be localized within 10 km from the pile driving location and to ensure that the PAM operator is able to review acoustic detections within 15 minutes of the original detection. As required by the proposed MMPA ITA, Atlantic Shores must submit a PAM plan to NMFS for approval that must include a description of all proposed PAM equipment, address how the proposed passive acoustic monitoring must follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind as described in *NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs* (Van Parijs *et al.,* 2021). With these requirements in place, we anticipate that use of PAM will be highly effective at detecting vocalizing marine mammals within 10 km of the pile being driven, which will enhance the detection capabilities of the PSOs and increase the effectiveness of the clearance and shutdown requirements. If the PAM operator has confidence that a vocalization originated from a right whale located within 10 km (the area that the PAM system will be able to effectively monitor for vocalizing right whales), the appropriate associated clearance or shutdown procedures must be implemented (i.e., delay or stop pile driving). As described in the proposed MMPA ITA, in the event that a large whale is acoustically detected that cannot be confirmed as a non-North Atlantic right whale, it must be treated as if it were a right whale for purposes of mitigation. Detection of vocalizing fin, sei, or sperm whales in the identified clearance and shutdown zones (see Table 7.1.16 above) will trigger the required delays or shutdown procedures. More details on PAM operator training and PAM protocols are included in the Notice of Proposed ITA (88 FR 65430).

If an ESA listed whale is observed entering or within the identified shutdown zone (see Table 7.1.16) after pile driving has begun, a shutdown must be implemented unless doing so would risk the loss of life or property that would result in the risk of the loss of human life; in such an instance, which is expected to be rare, lower hammer energy must be used. Additionally, pile driving must be halted upon visual observation of a North Atlantic right whale by PSOs or PAM detection of a vocalizing right whale at any distance from the pile. The purpose of a shutdown is to prevent exposure of individuals to noise above the cumulative Level A by halting the activity before such an exposure could occur. If a marine mammal is observed entering or within the respective shutdown zone after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving; similar requirements will be in place for PAM detections. In situations when shutdown is called for but Atlantic Shores determines shutdown is not feasible due to imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy must be implemented. As described in section 3.3, in rare instances, shutdown may not be feasible, as shutdown would result in a risk to human life. For example, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal (i.e., the limits of installation), and a shutdown would lead to a stuck pile which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. Pile instability occurs when the pile is unstable and unable to stay standing if the piling vessel were to "let go." During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shut-down combined with impending weather conditions may require the piling vessel to "let go," which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals as it means the pile would be released while unstable and could fall over. As explained above, the likelihood of shutdown being called for and not implemented is considered very low.

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

Consideration of the Effectiveness of Clearance and Shutdown Zones

Noise above the Level A peak harassment threshold is expected to extend no further than 80 m from a pile being installed (Table 7.1.9). This distance is expected to be within the bubble curtain. We consider it extremely unlikely that a whale would be that close to the pile (within the bubble curtain) and not be detected prior to the start of pile driving or that a whale could get that close to the pile during active pile driving. As such, we do not anticipate any exposure of any ESA listed whales to noise that could result in PTS due to a single pile strike.

The proposed clearance zone (2.3 km) is larger than the exposure range to the Level A cumulative threshold for all pile driving scenarios for right (even considering only the minimum visibility zone and not any further distance that a PSO may be able to see right whales), fin, sei, and sperm whales; the maximum distance to the Level A cumulative threshold across all pile scenarios for those species is 1.06 km for right whales, 1.9 km for fin and sei whales, and 0 for sperm whales. Pile driving cannot begin if a sei, fin, or sperm whale is detected by the visual PSOs or PAM operator within the clearance zone or if a right whale is detected by a visual PSO at any distance or by PAM detection within 10 km. As explained above, considering the minimum visibility requirements and placement of visual PSOs at the pile driving platform and on two vessels approximately 2 km from the pile being driven, we expect that the full extent of the clearance zone will be able to be monitored by the visual PSOs. Given the visibility requirements and the ability of the PSOs to monitor the entirety of the clearance zone, and the additional detection ability provided by the PAM system, it is unlikely that any pile driving would begin with a whale within the clearance zone.

Modeling predicted the exposure of a small number of right, sei, and fin whales to noise above the cumulative Level A harassment threshold. No exposure of sperm whales that could result in PTS is expected based on the distance to the Level A harassment threshold for mid-frequency cetaceans not being exceeded during pile driving.

As addressed above, considering all pile types, the clearance zone is at least 400 m (and up to 1.21 km) larger than the modeled species-specific exposure ranges for fin and sei whales. However, considering the modeled species-specific exposure ranges and the different pile types, the shutdown zone extends 0-810 m from the closest point of approach that modeling identifies as indicating a fin or sei whale had accumulated enough noise exposure to experience PTS. Considering the installation of 15 m monopiles and pre-piled pin piles, shutdown would not be triggered until an individual fin or sei whale was less than 100 m from of the area where modeling indicates PTS would occur and for post-piled pin piles, shutdown would not be triggered until a fin or sei whale was at the distance that modeling indicates PTS would occur. Given this, the proposed shutdown requirements may not prevent all exposure of fin and sei whales to noise above the cumulative Level A harassment threshold, particularly considering that shutdown may not be instant. This was considered in the proposed authorization of the take of 8 fin whales and 3 sei whales by Level A harassment in the proposed MMPA ITA. Although we expect that individuals will temporarily avoid the area during the foundation installation activities, and that monitoring of the clearance zone will be effective at reducing the potential for pile driving to start with a fin or sei whale in the clearance zone, given the factors outlined above, we cannot discount the potential for a fin or sei whale to transit the shutdown zone close enough to the pile being driven such that they are exposed to noise above the cumulative Level A harassment threshold. Atlantic Shores requested and NMFS OPR proposes to authorize, take in the amount of 100 percent of the modeled PTS exposures for these species. We have reviewed this assessment and agree that it is a reasonable determination; this is in consideration of the factors outlined above.

Modeling predicts the exposure of 0.46 right whales above the cumulative Level A harassment threshold over the entire duration of foundation pile driving (i.e., both construction seasons), considering installation of all piles with 10 dB sound attenuation. The model does not consider the pre-start clearance or shutdown requirements. The proposed action incorporates measures to reduce the risk of exposure to noise that could result in PTS for right whales. Based on the best available data NMFS expects that North Atlantic right whales to be present in the WDA predominantly from January – April (Roberts et al. 2023), with the highest density months outside of that period being May and December. Due to this seasonal pattern in North Atlantic right whale occurrence in the project area, we expect the most significant measure to minimize impacts to North Atlantic right whales is the prohibition on impact pile driving from January through April, when North Atlantic right whale abundance in the project area is greatest; however, we note that this seasonal restriction is already factored into the exposure estimate (i.e., the modeled exposure of 0.46 right whales is for pile driving that is limited to May – December each year).

During impact pile driving, PSOs and PAM will be used to monitor clearance and shutdown zones for right whales; the start of pile driving will be delayed on the sighting of a right whale, or any large whale that can not be confirmed is not a right whale, at any distance from the pile and upon detection of a vocalizing right whale within 10 km of the pile. Shutdown is triggered based on the same criteria. For right whales, considering only the 1.9 km minimum visibility zone from the pile driving platform, the clearance and shutdown zones exceed the modeled distances to the cumulative Level A harassment threshold by 840 to 1,340 m; given the distances that we expect the visual PSOs to be able to monitor (at least 3.8 km considering the PSOs at the pile driving platform and on PSO vessels), the area that would be visually monitored is more than three times as far from the pile as the closest point of approach that modeling suggests would indicate a right whale had accumulated enough noise exposure to experience PTS. For example, the largest CPA is 1.06 km for the four post-piled pin piles installed in a single day; we expect the PSOs to be able to detect a right whale at least 3.8 km from this pile, which would be 2,740 m before an animal swimming towards the pile reached the CPA (which is unexpected). Visual monitoring will be supplemented by PAM, which has the potential to detect vocalizing right whales that are too far away to be seen by the visual observer or that are submerged. The area monitored by PAM and where a detection would trigger delay or shutdown is even larger (extending 10 km from the pile), and pile driving will be delayed or stopped if a right whale is detected by a visual PSO at any distance from the pile or vocalizations are detected anywhere within 10 km of the pile. Given this, we consider it extremely unlikely that a right whale would be close enough to a pile to experience PTS (within 0.56 to 1.06 km of the pile depending on pile type) without a PSO or PAM operator detecting it and calling for a shutdown. In the event that shutdown cannot occur (i.e., to prevent imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals), the energy that the pile driver operates at will be reduced. The lower energy results in less noise and shorter distances to thresholds. As such, even if shutdown cannot occur, we do not expect that a right whale would remain close enough to the pile being driven for a long enough period to be exposed to noise above the Level A cumulative harassment threshold. We expect that these measures in combination with the requirements for monitoring North Atlantic right whale sightings reports for surrounding areas daily, which increases awareness of potential North Atlantic right whales in the WDA, and the low density of right whales in the WDA when pile driving could occur make it extremely unlikely that any of the modeled exposure to noise above the Level A threshold, which already was small (0.46 individuals), will occur. As a result of these mitigation measures, and in light of our independent review, we agree with BOEM's and NMFS OPR's determinations that the already small potential for North Atlantic right whales to be exposed to project-related sound above the Level A harassment threshold is extremely unlikely to occur. As such, as stated above, it is extremely unlikely that any right whales will experience permanent threshold shift or any other injury. We note that this contrasts with the assessment for sei and fin whales presented above due to the enhanced mitigation measures for right whales which will delay pile driving and trigger shutdown if right whales, or potential right whales, are detected at greater distances from the pile compared to fin and sei whales.

Given that the size of the area with noise above the Level B harassment threshold (up to 4.31 km for monopiles and 2.81 km for pin piles) is larger than the clearance and shutdown zone (compare the distances in Table 7.1.16 to Table 7.10), the clearance and shutdown procedures may limit the duration of exposure of fin, right, sei, and sperm whales to noise above the Level B harassment thresholds; however, they are not expected to eliminate the potential for exposure to noise above the Level B harassment threshold. We note that the sei and fin whales anticipated to be exposed to noise above the Level A threshold would also be exposed to noise above the Level

B harassment threshold. We also note that given the size of the area where noise will be above the Level B harassment threshold, not all whales that are exposed to noise above the Level B harassment threshold are likely to be observed by the PSOs. Therefore, we cannot reduce or refine the take estimates based on the Level B harassment thresholds in consideration of the effectiveness of the clearance or shutdown zone. We anticipate that, as modeled and proposed by NMFS OPR and BA, up to 2 fin, 12 right, 9 sei, and 6 sperm whales may be exposed to noise above the Level B threshold during the installation of foundation piles.

Soft Start
As described in the Notice of Proposed ITA, the use of a soft start procedure is believed to provide additional protection to marine mammals by warning marine mammals or providing them with a chance to leave the area prior to the hammer operating at full capacity, and typically involves a requirement to initiate sound from the hammer at reduced energy followed by a waiting period. Atlantic Shores will utilize soft start techniques for impact pile driving including by performing 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy (i.e., 440 to 880 KJ for monopiles, 250 to 550 kJ for jackets), for a minimum of 20 minutes. Soft start, which we consider part of the proposed action, would be required at the beginning of each day's impact pile driving work and at any time following a cessation of impact pile driving of thirty minutes or longer. Without soft start procedures, pile driving would begin with full hammer energy, which would present a greater risk of more severe impacts to more animals. In this context, soft start is a minimization measure designed to reduce the amount and severity of effects incidental to pile driving.

Use of a soft start can reduce the cumulative sound exposure if animals respond to a stationary sound source by swimming away from the source quickly (Ainslie et al. 2017). The result of the soft start will be an increase in underwater noise in an area radiating from the pile that is expected to exceed the Level B harassment threshold and, therefore, is expected to cause any whales exposed to the noise to swim away from the source. The use of the soft start gives whales near enough to the piles to be exposed to the soft start noise a "head start" on escape or avoidance behavior by causing them to swim away from the source. Through use of soft start, marine mammals are expected to move away from a sound source that is annoying, thereby avoiding exposure resulting in a serious injury and avoiding sound sources at levels that would cause hearing loss (Southall et al. 2007, Southall et al. 2016). It is possible that some whales may swim out of the noisy area before full force pile driving begins; in this case, the risk of whales being exposed to noise that exceeds the cumulative Level A harassment threshold would be reduced. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in Level A or Level B harassment. However, we are not able to predict the extent to which the soft start will reduce the number of whales exposed to pile driving noise or the extent to which it will reduce the duration of exposure. Therefore, while the soft start is expected to reduce the duration of exposure of pile driving noise, the level of reduction is uncertain, and we are not able to modify the estimated take numbers to account for any benefit provided by the soft start.

Summary of Noise Exposure Anticipated as a Result of Foundation Pile Driving
In summary, we expect that no ESA listed whales will be exposed to noise above the peak Level A harassment threshold; 8 fin whales and 3 sei whales will be exposed to noise above the

cumulative Level A thresholds; and, 21 fin, 12 right, 9 sei, and 6 sperm whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold. Below, following consideration of vibratory pile driving for cofferdam installation and removal, we consider the effects of these noise exposures.

Vibratory Pile Driving to Install and Remove Sheet Piles
As described in the proposed MMPA ITA, modeling was carried out to estimate the distances to relevant MMPA thresholds (i.e., Level A and B harassment) which were then used with density estimates to estimate the number of animals expected to be exposed to the pile driving noise at or above those threshold levels. Consistent with the requirements of the proposed MMPA ITA, Atlantic Shores will maintain a 100 m clearance zone (and 100 m shutdown zone) for vibratory pile driving of the sheet piles.

To support the MMPA ITA application, Atlantic Shores carried out propagation modeling using *in-situ* data using information from Illingworth & Rodkin (2017), which measured the sound exposure level at 10 m from sheet piles using a vibratory hammer. Additional information on the modeling approach is described in the Notice of Proposed ITA. Distances to MMPA Level A and Level B harassment thresholds were calculated as acoustic range ($R_{95\%}$) values (Table 7.1.17). Variation in acoustic ranges between the two sites is due to differing propagation loss properties. Peak Level A thresholds are not expected to be exceeded at any distance from the sheet piles.

Table 7.1.17 – Acoustic Ranges ($R_{95\%}$) in Meters to the cumulative Level A Harassment and Level B Harassment Thresholds from Vibratory Pile Driving During Temporary Cofferdam Installation and Removal

Marine Mammal Hearing Group	Atlantic Landfall Site				Monmouth Landfall Site			
	Level A harassment SEL_{cum} thresholds (dB re 1 µPa2·s)		Level B harassment SPL_{rms} threshold (120 dB re 1 µPa)		Level A harassment SEL_{cum} thresholds (dB re 1 µPa2·s)		Level B harassment SPL_{rms} threshold (120 dB re 1 µPa)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Low-frequency cetaceans	65	65	5,076	7,546	45	60	5,412	11,268
Mid-frequency cetaceans	0	0			0	0		

Given the very small distances to the cumulative Level A harassment thresholds (0-65 m), which accounts for 8 hours of pile driving, NMFS OPR determined that installation and removal of temporary cofferdams is not expected to result in exposure to any ESA-listed marine mammals to noise above the Level A harassment threshold. We agree with this assessment and note that exposure would require an individual animal to remain within 65 m of all piles being installed for the full duration of pile driving over the course of a day (13-14 piles over an 8-hour period, this is considering acoustic range not exposure range). The potential for this already unlikely occurrence is further reduced by the requirement to not start pile driving until an area extending at least 100 m from the pile is clear of whales and the requirement to shut down if a whale occurs within 100 m of the pile. Atlantic Shores did not request nor is NMFS OPR proposing to authorize any Level A harassment incidental to installation or removal of sheet piles.

As described in the Proposed ITA, the acoustic ranges to the Level B harassment threshold were used to calculate the ensonified area around the cable landfall construction site for the sheet piles. To estimate marine mammal density around the nearshore landfall site, the greatest ensonified area, was then intersected with the density grid cells for each individual species to select all of those grid cells that the area intersects. Density estimates are calculated from the 2022 Duke Habitat-Based Marine Mammal Density Models (Roberts et al., 2016; Roberts et al., 2023). The highest average monthly density from September through May (the time period the work would occur) for each species was used to estimate exposures. To calculate exposures, the marine mammal densities from Table 7.1.18 were multiplied by the daily ensonified area (104.3 km^2 for Atlantic and 221.77 km^2 for Monmouth) for installation/removal of sheet piles. Given the number of days of pile driving proposed, the daily estimated exposure (which is the product of density x ensonified area) was multiplied by 12 for Atlantic City (6 days installation and 6 days removal) and 16 for Monmouth (8 days installation and 8 days removal).

Table 7.1.18 – Maximum Monthly Densities (individuals/100 km^2) for September through May Used to Analyze Cofferdam Activities

Marine Mammal Species	Monmouth site	Atlantic site
North Atlantic right whale	0.035	0.092
Fin whale	0.117	0.052
Sei whale	0.046	0.018
Sperm whale	0.008	0.002

source: table 10 in Proposed MMPA ITA

Atlantic Shores and OPR considered the exposures predicted by these density-based estimates as well as average group size-based estimates (see Table 12 in the MMPA Proposed ITA). Atlantic Shores requested, and OPR is proposing to authorize, MMPA take based on adjustment of the density-based estimates with average group size (Table 7.1.19).

Table 7.1.19 – Estimated Exposures above the Level B Harassment Threshold and Amount of Take by Level B Harassment Proposed for Authorization for Cofferdam Activities (with Group Size Adjustment)

Species	Atlantic City Landfall - Exposures	Monmouth Landfall - Exposures	Atlantic City – Adjustment for Group Size	Monmouth - Adjustment for Group Size	Total Amount of Level B Take Proposed
North Atlantic right whale	1.15	1.23	4	4	8
Fin whale	0.65	4.14	2	5	7
Sei whale	0.23	1.62	3	3	6
Sperm whale	0.03	0.28	2	2	4

OPR is proposing to authorize the Level B take of 7 fin whales, 8 right whales, 6 sei whales, and 4 sperm whales as a result of exposure to vibratory pile driving noise; based on our independent analysis of the available information, we agree with this analysis and expect that this number of individuals will be exposed to noise above the Level B harassment threshold. As explained more fully below, we consider the effects to these individuals that result from the exposure of these individuals to noise above the Level B threshold but below the Level A threshold to meet the ESA definition of harassment.

As part of the Connected Action, an existing sheet pile bulkhead located within an existing marina basin at Atlantic City will be repaired/rehabilitated through the installation of approximately 356 linear feet of steel or vinyl sheet piles with a vibratory hammer. This work will occur within an existing commercial marina basin within Atlantic City. There is no information to suggest that ESA listed whales would occur in the inshore location where this work will occur. As such, exposure to this pile driving noise and any resulting effects are extremely unlikely to occur and are discountable.

7.1.3.2 Effects to ESA-Listed Whales from Exposure to Pile Driving Noise

As explained above, we anticipate that during impact pile driving for foundations, up to 8 fin whales and 3 sei whales will be exposed to noise above the cumulative Level A thresholds (and the Level B threshold) and, 21 fin, 12 right, 9 sei, and 6 sperm whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold. Additionally, we expect 8 fin whales, 7 right whales, 6 sei whales, and 4 sperm whales to be exposed to noise above the Level B harassment threshold during vibratory pile driving to install and remove cofferdams to support cable installation. Below, we consider the effects of these noise exposures.

Effects of Exposure to Noise above the Level A Harassment Threshold

As explained above, up to 8 fin whales and 3 sei whales are expected to be exposed to impact pile driving noise that is loud enough to result in Level A harassment in the form of permanent threshold shift (PTS); these animals will also be exposed to noise above the Level B harassment threshold and experience masking and behavioral effects as described below. Consistent with OPR's determination in the notice of proposed ITA, in consideration of the duration and intensity of noise exposure we expect that the consequences of exposures above the Level A harassment threshold would be in the form of slight PTS. PTS would consist of minor degradation of hearing capabilities occurring predominantly at frequencies one-half to one octave above the frequency of the energy produced by pile driving (*i.e*., the low-frequency region below 2 kHz) (Cody and Johnstone, 1981; McFadden, 1986; Finneran, 2015), not severe hearing impairment. If hearing impairment occurs, it is expected that the affected animal would permanently lose a few decibels in its hearing sensitivity, which is not likely to meaningfully affect its ability to forage and communicate with conspecifics, or detect environmental cues, that is, it is expected to result in a minor degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (i.e. the low-frequency region below 2 kHz), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which, given the limited impact to hearing sensitivity, is not likely to meaningfully affect its ability to forage and communicate with conspecifics. Further, it is not likely to be severe enough to prevent detection of acoustic cues such that it would not be able to detect, and to the extent acoustic detection is used for avoidance, avoid threats. For example, we do not expect that the PTS would prevent a fin or sei whale from using acoustic cues, to the extent they do, to detect and avoid vessels. No severe hearing impairment or serious injury is expected because of the received levels of noise anticipated and the short duration of exposure. NMFS defines "harm" in the definition of ESA "take" as "an act which actually kills or injures fish or wildlife (50 CFR 222.102). Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). The PTS anticipated is considered a minor but permanent auditory injury and is considered harm in the context of the ESA definition of take.

The measures designed to minimize exposure or effects of exposure that are proposed to be required by NMFS OPR through the terms of the ITA, and by BOEM through the conditions of COP approval, and implemented by Atlantic Shores–all of which are considered elements of the proposed action–make it extremely unlikely that any whale will be exposed to pile driving noise that would result in severe hearing impairment or serious injury. Severe hearing impairment or serious injury would require both greater received levels of noise and longer duration of exposure than are anticipated to result from the Atlantic Shores pile driving. The sound attenuation measures, clearance and shutdown requirements, and soft start all effectively limit the potential for exposure to noise that could result in severe hearing impairment or serious injury make the necessary noise exposure extremely unlikely to occur.

PTS is permanent, meaning the effects of PTS last well beyond the duration of the proposed action and outside of the action area as animals migrate. As such, PTS has the potential to affect aspects of the affected animal's life functions that do not overlap in time and space with the proposed action. The PTS anticipated is considered a minor auditory injury. With this minor degree of PTS, we do not expect it to affect any of any individuals' overall health, reproductive capacity, or survival. The 8 individual fin whales and 3 sei whales could be less efficient at locating conspecifics and/or have decreased ability to detect threats at long distances, but these animals are still expected to be able to locate conspecifics to socialize and reproduce, and are expected to be able to detect threats with enough time to avoid injury. For this reason, we do not anticipate that the instances of PTS will result in any other injuries or any impacts on foraging or reproductive success, inclusive of mating, gestation, and nursing, or survival of any of the fin or sei whales that experience PTS.

Effects of Exposure to Noise above the Level B Harassment Threshold but Below the Level A Harassment Threshold

Potential impacts associated with exposure above the Level B harassment threshold would include only temporary behavioral modifications, most likely in the form of avoidance behavior and/or potential alteration of vocalizations, as well as potential Temporary Threshold Shift (TTS). The 28 fin, 20 right, 15 sei, and 10 sperm whales exposed to noise above the Level B harassment threshold but below the Level A harassment threshold, as a result of exposure to impact or vibratory pile driving noise, are expected to experience TTS.

An extensive discussion of TTS is presented in the proposed MMPA ITA and is summarized here, with additional information presented in Southall et al. (2019) and NMFS 2018. TTS represents primarily tissue fatigue and is reversible (Henderson et al. 2008). In addition, investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.*, Ward, 1997; Southall *et al.*, 2019). Therefore, NMFS does not consider TTS, alone, to constitute auditory injury.

While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard; that is, the animal experiences a temporary loss of hearing sensitivity. TTS, thus, is a temporary hearing impairment and can last from a few minutes to days, be of varying degree, and occur across different frequency bandwidths. All of these factors determine the severity of the impacts on the affected individual, which can range from minor to more severe. In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Observations of captive odontocetes suggest that wild animals may have a mechanism to self-mitigate the impacts of noise exposure by dampening their hearing during prolonged exposures to loud sound, or if conditioned to anticipate intense sounds (Finneran, 2018, Nachtigall *et al.*, 2018).

Impact pile driving generates sounds in the lower frequency ranges (with most of the energy below 1-2 kHz but with a small amount energy ranging up to 20 kHz); therefore, in general and all else being equal, we would anticipate the potential for TTS as more likely to occur in frequency bands in which the animals communicate. However, we would not expect the TTS to span the entire communication or hearing range of any species, given the frequencies produced by pile driving do not span entire hearing ranges for any particular species. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities is not expected to span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species.

Generally, both the degree of TTS and the duration of TTS would be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). Source level alone is not a predictor of TTS. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which is not likely to occur considering the proposed mitigation and the anticipated movement of the animal relative to the stationary sources such as impact pile driving. The recovery time of TTS is also of importance when considering the potential impacts from TTS. In TTS laboratory studies--some using exposures of almost an hour in duration or up to 217 SEL--almost all individuals recovered within 1 day or less, often in minutes. We note that while the impact pile driving activities will last for up to 12 hours a day (if four pin piles are installed in a single day and vibratory pile installation/removal would occur for up to 8 hours a day, it is unlikely that ESA listed whales would stay in the close proximity to the source long enough to incur more severe TTS (see additional explanation below regarding anticipated duration of exposure). Overall, given that we do not expect an individual to experience TTS from pile driving on more than one day, the low degree of TTS and the short anticipated duration (less than a day), and that it is extremely unlikely that any TTS overlapped the entirety of a critical hearing range, we expect that, consistent with the literature cited above, the effects of TTS and any behavioral response resulting from this TTS will be limited to no more than 24 hours from the time of exposure. Effects of TTS resulting from exposure to Atlantic Shores' project noise are addressed more fully in the species specific sections below.

In order to evaluate whether or not individual behavioral responses, in combination with other stressors, impact animal populations, scientists have developed theoretical frameworks that can then be applied to particular case studies when the supporting data are available. One such framework is the population consequences of disturbance model (PCoD), which attempts to assess the combined effects of individual animal exposures to stressors at the population level (NAS 2017). Nearly all PCoD studies and experts agree that infrequent exposures of a single day or less are unlikely to impact individual fitness, let alone lead to population level effects (Booth et al. 2016; Booth et al. 2017; Christiansen and Lusseau 2015; Farmer et al. 2018; Harris et al. 2017; Harwood and Booth 2016; King et al. 2015; McHuron et al. 2018; NAS 2017; New et al. 2014; Pirotta et al. 2018; Southall et al. 2007; Villegas-Amtmann et al. 2015).

Since we expect that any exposures to disturbing levels of noise would be limited to significantly less time than an entire day (limited only to the time it takes to swim out of the area with noise above the Level B threshold, but never more than 12 hours (the time it would take to install four pin piles), and repeat exposures to the same individuals are unlikely (based on abundance, distribution and sightings data including that whales in the WDA are transient and not remaining in the area for extended periods), any behavioral responses that would occur due to animals being exposed to pile driving are expected to be temporary, with behavior returning to a baseline state shortly after the acoustic stimuli ceases (i.e., pile driving stops or the animal swims far enough away from the source to no longer be exposed to disturbing levels of noise). Given this, and our evaluation of the available PCoD studies, this infrequent, time-limited exposure of individuals to pile driving noise is unlikely to impact the overall, long-term fitness of any individual; that is, the anticipated disturbance is not expected to impact individual animals' health or have effects on individual animals' survival or reproduction. Specific effects to the different species are considered below.

North Atlantic Right Whales

We expect that up to 20 North Atlantic right whales may experience TTS and/or behavioral disturbance from exposure to pile driving noise (impact or vibratory). We expect that this will be up to 20 different individuals each experiencing exposure to pile driving noise above the Level B harassment threshold on a single day. We do not expect repeat exposures (i.e., the same individual exposed to multiple pile driving events) due to the short duration and intermittent natures of the pile driving noise and the limited residence time and transient nature of right whales in the area. That is, because right whales are not expected to stay in the WDA for any extended period of time (regardless of pile driving activity) we do not expect an individual to be present in the WDA for multiple days such that it could be exposed to multiple pile driving events. While right whales may be present throughout the year, right whales predominantly use the WDA as they migrate north in March and April and south in November and December. While opportunistic foraging may occur in the WDA if prey is available in suitable densities to trigger foraging behavior, the WDA is not an area where right whales are known to aggregate for foraging, and it is not known to support regular or sustained foraging. Additionally, neither mating nor calving are known or expected to occur in the WDA.

When in the action area surrounding and including the WDA, where noise exposure would occur, the primary activity North Atlantic right whales are expected to be engaged in is migration. However, we also expect the animals to perform other behaviors, including opportunistic foraging and resting. If North Atlantic right whales exhibited a behavioral response to the pile driving noise, the activity that the animal was carrying out would be disrupted, and it may pose some energetic cost; these effects are addressed below. Because use of this area is limited to transient individuals, we do not expect that animals displaced from a particular portion of the area due to exposure to pile driving noise would return to the area, rather, they would continue their normal behaviors from the location they moved to; these effects are addressed below. As noted previously, responses to pile driving noise are anticipated to be short-term (no more than about three to nine hours depending on the pile type and no more than 12 hours in a single day).

Right whales are considerably slower than the other whale species in the action area, with maximum speeds of about 9 kilometers per hour (kph). Hatin et al. (2013) report median swim speeds of singles, non mother-calf pairs, and mother-calf pairs in the southeastern United States recorded at 1.3 kph, with examples that suggest swim speeds differ between within-habitat movement and migration-mode travel (Hatin et al. 2013). Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area. During impact pile driving of foundations, the area with noise above the Level B harassment threshold extends up to approximately 2.81 km for pin piles and 4.31 km for monopiles; for sheet piles for cofferdams it extends approximately 5 to 11 km (dependent on time of year and location). As such, for foundation piles, considering a right whale that was at the edge of the minimum visibility zone (1.9 km) when pile driving starts, we would expect that right whale swimming at maximum speed (9 kph) would escape from the area with noise above 160 dBre 1uPa (extending 2.9 to 4.4 km from the pile) in less than 20 minutes, but at the median speed observed in Hatin et al. (1.3 kph, 2013), it would take the animal up to two hours to move out of the noisy area. For cofferdams, a right whale would swim out of the noisy area within 0.5 to 8.5 hours depending on the speed of the animal, location of exposure, and time of year.

Based on best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that exposed animals will be able to return to normal behavioral patterns (i.e., socializing, foraging, resting, migrating) after the exposure ends. If an animal exhibits an avoidance response, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. That said, migration is not considered a particularly costly activity in terms of energetics (Villegas-Amtmann et al. 2015). The up to 20 right whales exposed to pile driving noise may experience one-time, temporary, disruptions to foraging activity; this would be the case if a right whale was foraging while pile driving started and it stopped foraging to move away from the noise or if it was actively avoiding the noisy area and did not forage during that period. However, given the rarity of foraging in the WDA we consider this to be a very low probability of occurrence. As explained above, given that the duration of pile driving is short (3 to 9 hours for a single pile, with exposure expected to be less than that period), and we expect an individual to only be exposed to noise from a single pile driving event, we expect the potential for disruption of foraging to occur for a short period of time on a single day. Goldbogen et al. (2013a) hypothesized that if the temporary behavioral responses due to acoustic exposure interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location once it escapes the noisy area, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment following the cessation of acoustic exposure (i.e., the pile driving is not expected to disrupt copepod prey). There would likely be an energetic cost associated with any temporary displacement to find alternative locations for foraging, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (Southall et al. 2007a). Disruption of resting and socializing may also result in short term stress. Efforts have been made to try to quantify the potential consequences of responses to behavioral disturbance, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project.

Based on best available information that indicates whales resume normal behavior quickly in their new location after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the 20 individuals exposed to noise above the Level B harassment threshold will resume normal behavioral patterns (primarily migrating, but also resting, socialization, and potential limited, opportunistic foraging) after the exposure ends. If an animal exhibits an avoidance response, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. That said, migration is not considered a particularly costly activity in terms of energetics (Villegas-Amtmann et al. 2015). An animal that was migrating through the area and was exposed to pile driving noise would make minor alterations to their route, taking them 2.9 to 11 km out of their way depending on which pile driving noise they were avoiding. This is far less than the distance normally traveled over the course of a day (they have been tracked moving more than 80 km in a day in the Gulf of St. Lawrence) and we expect that even for stressed individuals or mother-calf pairs, this alteration in course would result in only a small energetic impact that would not have consequences for the animals health or fitness.

We have also considered the possibility that a resting animal could be exposed to pile driving noise and its rest disturbed. Resting would be disrupted until the animal moved outside of the area with increased pile driving noise. As explained above, we expect this disruption would likely last less than 20 minutes but could last up to 12 hours. Given that disruptions to resting will be a one-time event that likely lasts only a few minutes and at most a few hours, we expect that any exposed individuals would be able to make up that lost rest without consequences to their overall energy budget, health, or fitness.

Stress responses are also anticipated in the 20 right whales experiencing temporary behavioral disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal; this is true for all potentially exposed animals, including mother-calf pairs. The stress response is expected to fully resolve when the animal has moved away from the disturbing levels of noise; as such, the stress response is limited to the 20 minutes to up to 12 hours the individual right whales are expected to be exposed to disturbing levels of noise during impact pile driving. These short-term stress responses are not equivalent to stress responses and associated elevated stress hormone levels that have been observed in North Atlantic right whales that are chronically entangled in fishing gear (Rolland et al. 2017). This is also in contrast to stress level changes observed in North Atlantic right whales due to fluctuations in chronic ocean noise. Rolland et al. (2012) documented that stress hormones in North Atlantic right whales significantly decreased following the events of September 11, 2001 when shipping was significantly restricted. This was thought to be due to the resulting decline in ocean background noise level because of the decrease in shipping traffic. As noted in Southall et al. (2007a), substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are considered more likely to be significant if they last more than 24 hours, or recur on subsequent days; this is not the case here as the behavioral response and associated effects will in all cases last less than 12 hours (if a right whale was exposed to noise from all four pin piles installed in a day) and will not recur on subsequent days. Because we expect these 20 individuals to only be exposed to a single pile driving event, we do not expect chronic exposure to pile driving noise. In summary, we do not anticipate long duration exposures to occur, and we do not anticipate that behavioral disturbance and associated stress response as a result of exposure to pile driving noise will affect the health of any individual and therefore, there would be no consequences on body condition or other factor that would affect health, survival, reproductive or calving success**.**

As noted above, TTS represents primarily tissue fatigue and is reversible (Southall et al., 2007). Temporary hearing loss is not considered physical injury but will cause auditory impairment to animals over the short period in which the TTS lasts. The TTS experienced by up to 20 right whales is expected to be a minor degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (i.e. the low-frequency region below 2 kHz), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which, given the limited impact to hearing sensitivity, is not likely to meaningfully affect its ability to forage and communicate with conspecifics, including communication between mothers and calves. We anticipate that any instances of TTS will be of minimum severity and short duration. This conclusion is based on literature indicating that even following relatively prolonged periods of sound exposure resulting in TTS, recovery occurs quickly (Finneran 2015). TTS is expected to resolve within a day and in all cases would resolve within a week of exposure (that is, hearing sensitivity will return to normal) and is not expected to affect the health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity. Pile driving noise may mask right whale calls and could have effects on mother-calf communication and behavior. If such effects were severe enough to prevent mothers and calves from reuniting or initiating nursing, they may result in missed feeding opportunities for calves, which could lead to reduced growth, starvation, and even death. Any mother-calf pairs in the action area would have left the southern calving grounds and be making northward migrations to northern foraging areas. The available data suggests that North Atlantic right whale mother-calf pairs rarely use vocal communication on the calving grounds and so the two maintain visual contact until calves are approximately three to four months of age (Parks and Clark 2007; Parks and Van Parijs 2015; Root-Gutteridge et al. 2018; Trygonis et al. 2013). Such findings are consistent with data on southern right and humpback whales, which appear to rely more on mechanical stimulation to initiate nursing rather than vocal communication (Thomas and Taber 1984; Videsen et al. 2017). When mother-calf pairs leave the calving grounds and begin to migrate to the northern feeding grounds, if they begin to rely on acoustic communication more, then any masking could interfere with mother-calf reunions. For example, even though humpback whales do not appear to use vocal communication for nursing, they do produce low-level vocalizations when moving that have been suggested to function as cohesive calls (Videsen et al. 2017). However, when calves leave the foraging grounds at around four months of age, they are expected to be more robust and less susceptible to a missed or delayed nursing opportunity. Any masking would only last for the duration of the exposure to pile driving noise, which in all cases would be no more than 12 hours. As such, even if masking were to interfere with mother-calf communication in the action area, we do not anticipate that such effects would result in fitness or health consequences given their short-term nature. We also note that given the time of year restriction on impact pile driving and that mother-calf pairs are most likely to swim through the WDA in March and April (LaBreque et al. 2015) and are less likely to be present when impact pile driving occurs between May and December.

Quantifying the fitness consequences of sub-lethal impacts from acoustic stressors is exceedingly difficult for marine mammals, and we do not currently have data to conduct a quantitative analysis on the likely consequences of such sub-lethal impacts. While we are unable to conduct a quantitative analysis on how sub-lethal behavioral effects and temporary hearing impacts (i.e., masking and TTS) may impact animal vital rates (and therefore fitness), based on the best available information, we expect an increased likelihood of consequential effects when exposures and associated effects are long-term and repeated, occur in locations where the animals are conducting critical activities, and when the animal affected is in a compromised state. While we acknowledge that the 20 right whales exposed to pile driving noise may be in a compromised state, individual exposures will be short term (in most cases less than an hour but potentially for up to 12 hours) and none are expected to be repeated. The effects of this temporary exposure and associated behavioral response will not affect the health or fitness of any individual right whale.

Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to pile driving noise even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project. We do not anticipate that instances of behavioral response and any associated energy expenditure or stress will impact an individual's overall energy budget or result in any health or fitness consequences to any individual North Atlantic right whales.

We have also considered whether TTS, masking, or avoidance behaviors would be likely to increase the risk of vessel strike or entanglement in fishing gear. As explained above, we would not expect the TTS to span the entire communication or hearing range of right whales given the frequencies produced by pile driving do not span entire hearing ranges for right whales. Additionally, though the frequency range of TTS that right whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues. Masking may also make it more difficult for the individual to hear other animals or to detect auditory cues; however, masking resolves as soon as the animal moves sufficiently far from the source. As such, while TTS and masking may temporarily affect the ability of a right whale to communicate with other right whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats, we do not expect these effects to be so severe that they would prevent the affected individual from communicating or limit their response to acoustic cues such that it would prevent them from responding to a threat. For example, to the extent that a right whale relies on acoustic cues to detect and move away from nearby vessels, which is largely unknown, TTS and/or masking could slow the animal's response time. However, these risks are lowered by the limited scope of the TTS and lowered further by the short duration of TTS (less than a week) and masking (limited only to the time that the whale is exposed to the pile driving noise, so less than 12 hours). As such, while TTS and masking may increase the likelihood of injury by temporarily affecting the ability of an individual to use acoustic cues to respond to threats or stressors, the effects are not expected to be so severe to actually increase the risk that a right whale will be exposed to a threat such as being hit by a vessel or become entangled in fishing gear.

While we do expect pile driving noise to cause avoidance and temporary localized displacement as discussed above, we do not expect that avoidance of pile driving noise would result in right whales moving to areas with higher risk of vessel strike or entanglement in fishing gear. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that an individual whale is expected to avoid (no more than 11 km from the pile being installed), the short term nature of any disturbance, the limited number of whales impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 11 km area that would put an individual whale at greater risk of vessel strike or entanglement/capture.

The ESA's definition of take includes harassment of a listed species. NMFS Interim Guidance on the ESA Term "Harass" (PD 02-110-19; December 21, 2016[44] provides for a four-step process to determine if a response meets the definition of harassment. The Interim Guidance defines harassment as to "[c]reate the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." The guidance states that NMFS will consider the following steps in an assessment of whether proposed activities are likely to harass: 1) Whether an animal is likely to be exposed to a stressor or disturbance (i.e., an annoyance); and 2) The nature of that exposure in terms of magnitude, frequency, duration, etc. Included in this may be type and scale as well as considerations of the geographic area of exposure (e.g., is the annoyance within a biologically important location for the species, such as a foraging area, spawning/breeding area, or nursery area?); 3) The expected response of the exposed animal to a stressor or disturbance (e.g., startle, flight, alteration [including abandonment] of important behaviors); and 4) Whether the nature and duration or intensity of that response is a significant disruption of those behavior

[44] Available at: https://www.fisheries.noaa.gov/national/laws-and-policies/protected-resources-policy-directives

patterns which include, but are not limited to, breeding, feeding, or sheltering, resting or migrating.

Here, we carry out that four-step assessment to determine if the effects to the 20 individuals expected to be exposed to noise above the Level B harassment threshold meet the definition of harassment. We have established that up to 20 individual right whales will be exposed to levels of noise above the threshold at which we expect TTS and behavioral response to occur, we also expect exposure to noise will result in masking and a stress response (step 1). For an individual, the nature of this exposure is expected to be limited to a one-time exposure to pile driving noise and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the pile event (up to 12 hours), with TTS lasting for as long as a week; this disruption will occur in areas where individuals are expected to primarily be migrating but also could be foraging, resting, or socializing (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the Level B harassment threshold (traveling up to 2.2-11km). As explained above, these individuals are expected to experience TTS (temporary hearing impairment), masking, stress, disruptions to behaviors including foraging, resting, socializing, and migrating, and, energetic consequences of moving away from the pile driving noise (step 3). As explained above, breeding and calving do not occur in the action area or do not occur at the time of year when exposure to pile driving could occur. Together, these effects will significantly disrupt a right whale's normal behavior for the period that the exposure occurs, additionally TTS is expected to affect the animal's behavior, including limited impacts on its ability to communicate and use acoustic cues to detect and respond to threats for the period before TTS resolves (up to a week); that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the 20 right whales exposed to pile driving noise louder than 160 dB re 1uPa rms threshold are likely to be adversely affected and that effect amounts to ESA take by harassment. As such, we expect the take by harassment of 20 right whales as a result of pile driving noise.

NMFS defines "harm" in the ESA's definition of "take" as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). No right whales will be injured or killed due to exposure to pile driving noise. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual right whales on the day that the whale is exposed to the pile driving noise as well as for the period before TTS resolves (i.e., when hearing sensitivity returns to normal) creating the likelihood of injury, it will not actually kill or injure any right whales by significantly impairing any essential behavioral patterns. This is because behavioral disturbance, displacement, potential loss of foraging opportunities, and expending additional injury, will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in nursing, breeding, or calving. TTS will resolve within no more than a week of exposure and while it may temporarily affect the individual's ability to communicate and/or use acoustic cues to respond to threats, it is not expected to affect the health of any whale or affect the ability to detect and respond to threats in a way that would result in actual injury, or affect its ability to migrate, forage, breed, calve, or raise its young. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to socialize, migrate, forage, breed, calve, or raise its young. Thus, as no injury or mortality will actually occur, the response of right whales to pile driving noise does not meet the definition of "harm." We note that this analysis considers that some right whales are likely to be in a compromised state when exposed to Atlantic Shores pile driving noise.

Fin, Sei and Sperm Whales
Behavioral responses may impact health through a variety of different mechanisms, but most Population Consequences of Disturbance models focus on how such responses affect an animal's energy budget (Costa et al. 2016c; Farmer et al. 2018; King et al. 2015b; NAS 2017; New et al. 2014; Villegas-Amtmann et al. 2017). Responses that relate to foraging behavior, such as those that may indicate reduced foraging efficiency (Miller et al. 2009) or involve the complete cessation of foraging, may result in an energetic loss to animals. Other behavioral responses, such as avoidance, may have energetic costs associated with traveling (NAS 2017). When considering whether energetic losses due to reduced foraging or increased traveling will affect an individual's fitness, it is important to consider the duration of exposure and associated response. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget and that long duration and repetitive disruptions would be necessary to result in consequential impacts on an animal (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). As explained below, individuals exposed to pile driving noise will experience only a singular, temporary behavioral disruption that will not last for more than a few hours and will not be repeated. As such, the factors necessary for behavioral disruption to have consequential impacts on an animal are not present in this case. We also recognize that aside from affecting health via an energetic cost, a behavioral response could result in more indirect impacts to health and/or fitness. For example, if a whale hears the pile driving noise and avoids the area, this may cause it to travel to an area with other threats such as vessel traffic or fishing gear. However, as explained below, this is extremely unlikely to occur.

Quantifying the fitness consequences of sub-lethal impacts from acoustic stressors is exceedingly difficult for marine mammals and we do not currently have data to conduct a quantitative analysis on the likely consequences of such sub-lethal impacts. While we are unable to conduct a quantitative analysis on how sub-lethal behavioral effects and temporary hearing impacts (i.e., masking) may impact animal vital rates (and therefore fitness), based on the best available information, we expect an increased likelihood of consequential effects when exposures and associated effects are long-term and repeated, occur in locations where the animals are conducting normal or essential behavioral activities, and when the animal affected is in a compromised state.

We do not have information to suggest that affected sperm, sei, or fin whales are likely to be in a compromised state (i.e., suffering from an injury or illness that would change the effects of the action) at the time of exposure. During exposure, affected animals may be engaged in migration, foraging, or resting. If fin, sei, or sperm whales exhibited a behavioral response to pile driving noise, these activities would be disrupted, and the disruption may pose some energetic cost. However, as noted previously, responses to pile driving noise are anticipated to be singular and short term (up to three to nine hours depending on pile type); that is, the identified number of individuals are each expected to be exposed to a single pile driving event that will result in the individual altering their behavior to avoid the disturbing level of noise. Based on the estimated abundance of fin, sei, and sperm whales in the action area, anticipated residency time in the lease area, and the number of instances of behavioral disruption expected, multiple exposures of the same animal are not anticipated. Sperm whales normal cruise speed is 5-15 kph, with burst speed of up to 35-45 kph for up to an hour. Fin whales cruise at approximately 10 kph while feeding and have a maximum swim speed of up to 35 kph. Sei whales swim at speeds of up to 55 kph. During impact pile driving, the area with noise above the Level B harassment threshold extends up to approximately 2.9 to 4.4 km from the pile being driven. Assuming that a whale exposed to noise above the Level B harassment threshold takes a direct path to get outside of the noisy area, a sperm, fin, or sei whale that was at the edge of the clearance zone (2.3 km from the pile) when pile driving starts, would escape from the area with noise above 160 dB re 1uPa the noise in less than an hour, even at a slow speed of 5 kph; actual time spent swimming away from the noise is likely to be significantly less.

Considering the density and distribution of fin, sei, and sperm whales in the WDA and their known prey, disruptions of foraging activity are most likely for individual fin whales. Goldbogen et al. (2013a) suggested that if the documented temporary behavioral responses interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this will occur, particularly since unconsumed prey would still be available in the environment following the cessation of acoustic exposure (i.e., the pile driving is not expected to result in a reduction in prey). There would likely be an energetic cost associated with any temporary habitat displacement to find alternative locations for foraging, but unless disruptions occur over long durations or over subsequent days, we do not anticipate this movement to be consequential to the animal over the long-term (Southall et al 2007). Based on the estimated abundance of fin, sei, and sperm whales in the action area, anticipated residency time in the lease area, and the number of instances of behavioral disruption expected, multiple exposures of the same animal are not anticipated. Therefore, we do not anticipate repeat exposures, and based on the available literature that indicates infrequent exposures are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015), we do not expect this level of exposure to impact the fitness of exposed animals.

For fin, and sei whales, little information exists on where they give birth as well as on mother-calf vocalizations. There is no indication that sperm whale calves occur in the action area. As such, it is difficult to assess whether masking could significantly interfere with mother-calf communication in a way that could result in fitness consequences. In our judgment it is reasonable to assume here that it is likely that some of the sei or fin whales exposed to pile driving noise are mother-calf pairs. Absent data on mother-calf communication for these species within the action area, we rely on our analysis of the effects of masking to North Atlantic right whales, which given their current status, are considered more vulnerable than any of these whale species. Based on this analysis, we expect that any effects of TTS and/or masking on communication or nursing by fin or sei whale mother-calf pairs will be extremely unlikely to occur or will be so small that they cannot be meaningfully measured, evaluated, or detected; therefore, all effects of TTS and/or masking on mother-calf fitness will be insignificant or discountable.

We have also considered whether TTS, masking, or avoidance behaviors would be likely to increase the risk of vessel strike or entanglement in fishing gear. As explained above, we would not expect the TTS to span the entire communication or hearing range of fin, sei, or sperm whales given the frequencies produced by pile driving do not span entire hearing ranges for any whales. Additionally, though the frequency range of TTS that fin, sei, or sperm whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. Masking may also make it more difficult for the individual to hear other animals or to detect auditory cues; however, masking resolves as soon as the animal moves sufficiently far from the source. As such, while TTS and masking may temporarily affect the ability of a whale to communicate with other whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats, we do not expect these effects to be so severe that they would prevent the affected individual from communicating or limit their response to acoustic cues such that it would prevent them from responding to a threat. For example, to the extent that an individual whale relies on acoustic cues to detect and move away from nearby vessels, which is largely unknown, TTS and/or masking could slow the animal's response time. However, these risks are lowered by the limited scope of the TTS and lowered further by the short duration of TTS (less than a week) and masking (limited only to the time that the whale is exposed to the pile driving noise, so less than 12 hours). As such, while TTS and masking may increase the likelihood of injury by temporarily affecting the ability of an individual to use acoustic cues to respond to threats or stressors, the effects are not expected to be so severe to actually increase the risk that a right whale will be exposed to a threat such as being hit by a vessel or become entangled in fishing gear.

While we do expect pile driving noise to cause avoidance and temporary localized displacement as discussed above, we do not expect that avoidance of pile driving noise would result in right, fin, sei, or sperm whales moving to areas with higher risk of vessel strike or entanglement in fishing gear. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that an individual whale is expected to avoid (no more than 11 km from the pile being installed), the short term nature of any disturbance, the limited number of whales impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 11 km area that would put an individual whale at greater risk of vessel strike or entanglement/capture.

We set forth the NMFS interim guidance definition of ESA take by harassment above and the four-step analysis to evaluate whether harassment is likely to occur. Here, we carry out that four-step assessment to determine if the effects to the up to 28 fin, 15 sei, and 10 sperm whales expected to be exposed to noise above the Level B harassment threshold, but below the Level A harassment threshold, meet the ESA definition of harassment. We have established that up to 28 fin, 15 sei, and 10 sperm whales will be exposed to levels of noise above the threshold at which we expect TTS and behavioral response to occur, we also expect exposure to noise will result in masking (step 1). For an individual, the nature of this exposure is expected to be limited to a one-time exposure to pile driving noise and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the pile driving in a single day (up to 12 hours), with TTS lasting for as long as a week; this disruption will occur in areas where individuals are expected to primarily be migrating but also could be foraging, resting, or socializing (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the Level B harassment threshold (traveling up to 2.2-11km). As explained above, these individuals are expected to experience TTS (temporary hearing impairment), masking, stress disruptions to behaviors including foraging, resting, socializing, and migrating, and, energetic consequences of moving away from the pile driving noise (step 3). As explained above, breeding and calving do not occur in the action area or do not occur at the time of year when exposure to pile driving could occur. Together, these effects will significantly disrupt a right whale's normal behavior for the period that the exposure occurs, additionally TTS is expected to affect the animal's behavior, including limited impacts on its ability to communicate and use acoustic cues to detect and respond to threats for the period before TTS resolves (up to a week); that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the 29 fin, 15 sei, and 10 sperm whales exposed to pile driving noise louder than 160 dB re 1uPa rms threshold are likely to be adversely affected and that effect amounts to ESA take by harassment. As such, we expect the ESA take by harassment of up to 29 fin, 15 sei, and 10 sperm whales as a result of exposure to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold.

As noted, NMFS defines "harm" for ESA take purposes as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering." No fin, sei, or sperm whales will be injured or killed due to exposure to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual whales on the day that the whale is exposed to the pile driving noise as well as for the period before TTS resolves (i.e., when hearing sensitivity returns to normal) creating the likelihood of injury, it will not actually kill or injure any individuals by significantly impairing any essential behavioral patterns. This is because the effects will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in nursing, breeding, or calving. TTS will resolve within no more than a week of exposure and while it may temporarily affect the individual's ability to communicate and/or use acoustic cues to respond to threats, and is not expected to affect the health of any whale or its ability to migrate, forage, breed, calve, or raise its young. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to socialize, migrate, forage, breed, calve, or raise its young. Thus, as no injury or mortality will actually occur, the response of fin, sei, or sperm whales to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold does not meet the ESA definition of "harm."

Effects of Exposure to Other Project Noise Sources

Vessel Noise and Cable Installation

The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with the generalized hearing range for sei, fin, and right whales (7 Hz to 35 kHz) and sperm whales (150 Hz to 160 kHz) and would therefore be audible. As described in the BA, vessels without ducted propeller thrusters would produce levels of noise of 150 to 170 dB re 1 μPa-1 meter at frequencies below 1,000 Hz, while the expected sound-source level for vessels with ducted propeller thrusters level is 177 dB (RMS) at 1 meter. For ROVs, source levels may be as high as 160 dB. Given that the noise associated with the operation of project vessels is below the thresholds that could result in injury, no injury is expected. Noise produced during cable installation is dominated by the vessel noise; therefore, we consider these together.

Marine mammals may experience masking due to vessel noises. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007a) as well as increasing the amplitude (intensity) of their calls (Parks et al. 2011a; Parks et al. 2009). Right whales also had their communication space reduced by up to 84 percent in the presence of vessels (Clark et al. 2009a). Although humpback whales did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected, potentially indicating some signal masking (Dunlop 2016).

Vessel noise can potentially mask vocalizations and other biologically important sounds (e.g., sounds of prey or predators) that marine mammals may rely on. Potential masking can vary depending on the ambient noise level within the environment, the received level and frequency of the vessel noise, and the received level and frequency of the sound of biological interest. In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 μPa in the band between 10 Hz and 10 kHz due to a combination of natural (e.g., wind) and anthropogenic sources (Urick 1983a), while inshore noise levels, especially around busy ports, can exceed 120 dB re 1 μPa. When the noise level is above the sound of interest, and in a similar frequency band, masking could occur. This analysis reasonably assumes that any sound that is above ambient noise levels and within an animal's hearing range may potentially cause masking. However, the degree of masking increases with increasing noise levels; a noise that is just detectable over ambient levels is unlikely to cause any substantial masking.

Vessel noise has the potential to disturb marine mammals and elicit an alerting, avoidance, or other behavioral reaction. These reactions are anticipated to be short-term, likely lasting the amount of time the vessel and the whale are in close proximity (e.g., Magalhaes et al. 2002; Richardson et al. 1995d; Watkins 1981a), and not consequential to the animals. We also note that we do not anticipate any project vessels to occur within close proximity of any ESA listed whales; regulations prohibit vessels from approaching right whales closer than 500m and the vessel strike avoidance measures identified in Section 3 (inclusive of Appendix A and B) are expected to ensure no project vessels operate in close proximity to any whales in the action area. Additionally, short-term masking could occur. Masking by passing ships or other sound sources transiting the action area would be short term and intermittent, and therefore unlikely to result in any substantial costs or consequences to individual animals or populations. Areas with increased levels of ambient noise from anthropogenic noise sources such as areas around busy shipping lanes and near harbors and ports may cause sustained levels of masking for marine mammals, which could reduce an animal's ability to find prey, find mates, socialize, avoid predators, or navigate.

Based on the best available information, ESA-listed marine mammals are either not likely to respond to vessel noise or, if they did respond, the effects of such response would be so minor that the effect cannot be meaningfully evaluated or detected. Therefore, the effects of vessel noise on ESA-listed marine mammals are insignificant. No incidental take is anticipated.

Operation of WTGs

As described above, many of the published measurements of underwater noise levels produced by operating WTGs range from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Atlantic Shores project. As explained in section 7.1.2, data from the Block Island Wind Farm which has direct-drive GE Haliade 150-6 MW turbines (Elliot et al. 2019) and the 12 MW CVOW turbines (HDR 2023) is the best available data for estimating operational noise of the Atlantic Shores turbines.

In considering the potential effects of operational noise on ESA listed whales we consider the expected noise levels from the operational turbines and the ambient noise (i.e., background noise that exists without the operating turbines) in the WDA. Ambient noise is a relevant factor because if the operational noise is not louder than ambient noise we would not expect an animal to react to it.

Ambient noise includes the combination of biological, environmental, and anthropogenic sounds occurring within a particular region. In temperate marine environments including the WDA, major contributors to the overall acoustic ambient noise environment include the combination of surface wave action (generated by wind), weather events such as rain, lightning, marine organisms, and anthropogenic sound sources such as ships. In temperate marine environments including the WDA, major contributors to the overall acoustic ambient noise environment include the combination of surface wave action (generated by wind), weather events such as rain, lightning, marine organisms, and anthropogenic sound sources such as ships. The coastal waters off New Jersey have relatively high levels of ambient noise, attributed to nearby shipping noise (Rice et al. 2014). Salisbury et al. 2018 monitored ambient noise off the coast of Virginia in consideration of the hearing frequencies of a number of marine mammal species. In the right whale frequency band (71-224 Hz), ambient noise exceeded 110 dB 50% of the time and 115 dB 14% of the time. Noise levels in the fin whale frequency band (18-28 Hz) were lower than the other whale species, with noise levels exceeding 100 dB 50% of the time. Kraus et al. (2016) surveyed the ambient underwater noise environment in the RI/MA WEA. Depending on location, ambient underwater sound levels within the RI/MA WEA varied from 96 to 103 dB in the 70.8- to 224-Hz frequency band at least 50% of the recording time, with peak ambient noise levels reaching as high as 125 dB in proximity to the Narraganset Bay and Buzzards Bay shipping lanes (Kraus et al. 2016). Similar to the conclusions of Rice et al. (2014) for New Jersey, low-frequency sound from large marine vessel traffic in these and other major shipping lanes to the east (Boston Harbor) and south (New York) were the dominant sources of underwater noise in the RI/MA WEA.

Elliott et al. (2019) notes that the direct-drive turbines measured at BIWF generated operational noise above background sound levels at the measurement location of 50 m (164 ft.) from the foundation. The authors also conclude that even in quiet conditions (i.e., minimal wind or weather noise, no transiting vessels nearby), operational noise at any frequency would be below background levels within 1 km (0.6 mi) of the foundation. This information suggests that in quiet conditions, a whale located within 1 km of the foundation may be able to detect operational noise above ambient noise conditions. However, given the typical ambient noise in the WDA, we expect these instances of quiet to be rare. Regardless, detection of the noise does not mean that there would be any effect to the individual. While HDR 2023 did not specifically report distances above ambient, they reported that noise within 350 of an operating 12 MW turbine was between 120 and 130 dB and only exceeded 145 dB during storm conditions. Giving the ambient noise levels reported above, the distances to ambient appear to be slightly larger for the CVOW piles compared to BIWF.

Elliot et al. (2019) conclude that based on monitoring of underwater noise at the Block Island site, under most intense condition likely to occur, no risk of temporary or permanent hearing damage (PTS or TTS) could be projected even if an animal remained in the water at 50 m (164 ft.) from the turbine for a full 24-hour period. As such, we do not expect any PTS, TTS, or other potential injury to result from even extended exposure to the operating WTGs. The loudest noise recorded by Elliot et al. (2019) was 126 dB re 1uPa at 50 m from the turbine when wind speeds exceeded 56 km/h; at wind speeds of 43.2 km/h and less, measured noise did not exceed 120 dB re 1uPa at 50 m from the turbine (Eliot et al. 2019). As noted above, based on wind speed records within the WDA (Atlantic Shores COP) and the nearby Ambrose Buoy, the annual maximum wind speed (10-minute average) is 50.3 mph in the WDA and instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, with wind speeds exceeding 40 km/h less than 3% of the time across a year. HDR 2023 reached similar conclusions, noting that in no conditions did noise exceed NMFS TTS or PTS thresholds for marine mammals.

If whales avoided areas with noise above 120 dB, based on the results from Eliot et al. 2019 and HDR 2023, we would expect operational noise to result in avoidance of an area less than 350 m from any pile. We also note that in some conditions, an even smaller area may have noise above ambient noise. Given the conditions necessary to result in noise above 120 dB re 1uPa (as predicted by Eliot et al. 2019) only occur less than 3% of the time on an annual basis, and that in such windy conditions ambient noise is also increased, we do not anticipate the underwater noise associated with the operations noise of the direct-drive WTGs to result in avoidance of an area more than 350m from the WTG foundation. Given the small and dispersed nature of any areas that may be avoided, even if ESA-listed marine mammals avoided the area with noise above ambient, any effects would be so small that they could not be meaningfully measured, detected, or evaluated, and are therefore insignificant.

We recognize that the data from Elliot et al. (2019) and HDR 2023 represents WTGs that are of a smaller capacity than those proposed for use at Atlantic Shores (6 and 12 MW respectively). We also recognize the literature that has predicted larger sound fields for larger turbines. However, we also note that Tougaard et al. (2020) and Stober and Thomsen (2021) both indicate that operational noise is less than shipping noise; this suggests that in areas with consistent vessel traffic, such as the Atlantic Shores WDA, operational noise is not expected to be detectable above ambient noise at a distance more than 350 m from the foundation. Additionally, while there are no studies documenting distribution of large whales in an area before and after construction of a wind farm, data from other marine mammals (harbor porpoise) indicates that any reduction in abundance in the wind farm area that occurred during the construction period resolves and that harbor porpoise are as abundant in the wind farm area during project operations as they were before (Tougaard et al. 2006, Teilmann and Carstensen 2012, Thompson et al. 2010, Scheidat et al. 2011). These studies indicate that marine mammals in general will not be displaced from operational wind farms as a result of operational noise. We consider these reports to support our determination that effects of operational noise are likely to be insignificant and not result in the disruption or displacement of ESA listed whales.

HRG Survey Equipment
HRG surveys are planned within the lease area and cable routes and are elements of the proposed action under consultation in this opinion. A number of minimization measures for HRG surveys are also included as part of the proposed action. This includes maintenance of a 500 m clearance and shutdown zone for North Atlantic right whales and 100 m clearance and shutdown zone for other ESA listed marine mammals during the operations of equipment that operates within the hearing frequency of these species (i.e., less than 180 kHz).

In their ITA application, Atlantic Shores requested Level B harassment take associated with HRG surveys during the 5-year effective period of the ITA. The isopleth distances corresponding to the Level B harassment threshold for each type of HRG equipment with the potential to result in harassment of marine mammals were calculated per NMFS' Interim Recommendation for Sound Source Level and Propagation Analysis for HRG Sources. The distances to the 160 dB RMS re 1 μPa isopleth for Level B harassment are presented in Table 7.1.20 (see also Table 22 in the proposed MMPA ITA). The LOA application contains a full description of the methodology and formulas used to calculate distances to the Level B harassment threshold. NMFS OPR determined that the only proposed equipment with the potential to result in exposure of whales to noise above the Level B threshold are the CHIRP and sparkers.

Table 7.1.20 Distances to the Level B Harassment Thresholds for Each HRG Sound Source or Comparable Sound Source Category for Each Marine Mammal Hearing Group

Equipment Type	Representative Model	Level B Harassment Threshold (m)
		All (SPL_{rms})
CHIRP	EdgeTech 216	9
	EdgeTech 424	10
	EdgeTech 512i	9
	Edgetech 2000-DSS	56
	Pangeosubsea Sub-Bottom Imager	32
Sparker	Applied Acoustics Dura-Spark 240	141
	GeoMarine Geo-Source	56

source: table 22

The basis for the MMPA take estimate is the number of marine mammals that would be exposed to sound levels in excess of the Level B harassment threshold (160 dB). Typically, this is determined by estimating an ensonified area for the activity, by calculating the area associated with the isopleth distance corresponding to the Level B harassment threshold. This area is then multiplied by marine mammal density estimates in the project area and then corrected for seasonal use by marine mammals, seasonal duration of Project-specific noise-generating activities, and estimated duration of individual activities when the maximum noise-generating activities are intermittent or occasional. More information on the density estimates and calculations used are presented in the Notice of Proposed ITA.

Table 7.1.21 presents the amount of take (MMPA Level B harassment) proposed for authorization by NMFS OPR for the 5-years of HRG surveys considered in the proposed LOA. See also Table 23 in the Proposed ITA.

Table 7.1.21. Amount of MMPA Take by Level B Harassment Proposed for Authorization for 5-years of HRG Surveys

	Level A	**Level B**
Fin Whale	0	10
North Atlantic Right Whale	0	5

Sei Whale	0	10
Sperm Whale	0	5

source: table 23 in Proposed MMPA ITA

NMFS OPR is proposing to authorize the take, by Level B harassment, of 5 right whales, 10 fin whales, 10 sei whales, and 5 sperm whales due to exposure to noise from HRG surveys over a five year period. As explained above, given the difference in the definitions between MMPA harassment and NMFS guidance defining take by harassment under the ESA, it is reasonable for NMFS OPR to find, in certain instances, that noise is likely to result in MMPA Level B harassment (i.e. potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns) , while we determine that the intensity of those impacts is not severe enough to cause take by harassment under the ESA (i.e. create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns). As described below, we do not expect that exposure of any ESA listed whales to noise resulting from HRG surveys will result in any take by harassment as defined by the ESA. That is, we have determined that exposure of any ESA listed whales to noise above ESA behavioral harassment threshold or at levels anticipated to cause take by harassment is extremely unlikely to occur. Further, if any exposure to noise resulting from HRG surveys were to occur, we expect the effects to be of very brief duration and marginal intensity causing only minor behavioral reactions and not TTS (i.e. so minor that they could not be detected, measured or evaluated). We do not expect any effects to any ESA-listed whale's hearing to result from exposure to HRG noise sources. Based on these considerations, we have determined that all effects of exposure to HRG survey noise to be either insignificant or discountable. The basis for this conclusion is set forth below.

Extensive information on HRG survey noise and potential effects of exposure to ESA listed whales is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021) which we consider the best available science and information on these effects. We summarize the relevant conclusions here. Based on the characteristics of the noise sources planned, no ESA listed whales are anticipated to be exposed to noise above the Level A harassment thresholds (peak or cumulative). The peak noise threshold is not exceeded at any distance; the cumulative noise threshold is less than 1.5m. It is extremely unlikely that a whale would be close enough to the sound source to experience any exposure at all, and even less likely that it would experience sustained exposure. This is due to both the very small distance from the source that noise above the threshold extends (1.5 m) and because the sound source is being towed behind a vessel and therefore is moving. Considering the loudest source that would be used for the surveys (Applied Acoustics Dura-Spark), the distance to the Level B harassment threshold extends approximately 141 m from the source. Given the very small area ensonified and considering the source is moving, any exposure of ESA listed whales to noise above the Level B harassment threshold is extremely unlikely to occur. The use of PSOs to monitor a clearance and shutdown zone (500 m for right whales and 100 m for other ESA listed whales) makes exposure even less likely to occur.

In the unlikely event that a whale did get within 141 m of the source (the maximum distance from the source where noise is above the Level B harassment threshold), we expect that the result of this exposure would be, at worst, temporary avoidance of the area with underwater noise louder than this threshold, which is a reaction that is considered to be of low severity and with no lasting biological consequences (e.g., Southall et al. 2007). The noise source itself will be moving. This means that any co-occurrence between a whale, even if stationary, and the noise source will be brief and temporary. Given that exposure will be short (no more than a few seconds, given that the noise signals themselves are short and intermittent and because the vessel towing the noise source is moving) and that the reaction to exposure is expected to be limited to changing course and swimming away from the noise source only far/long enough to get out of the ensonified area (141 m or less), the effect of this exposure and resulting response will be so small that it will not be able to be meaningfully detected, measured or evaluated and, therefore, is insignificant. Further, the potential for substantial disruption to activities such as feeding (including nursing), resting, and migrating is extremely unlikely given the very brief exposure to any noise (given that the source is traveling and the area ensonified at any given moment is so small). Any brief interruptions of these behaviors are not anticipated to have any lasting effects. Additionally, given the extremely short duration of any measurable behavioral disruption and the very small distance any animal would have to swim to avoid the noise it is extremely unlikely that the behavioral response would increase the risk of exposure to other threats including vessel strike or entanglement in fisheries gear. The effects of these temporary behavioral changes are so minor as to be insignificant. Insignificant effects are not adverse effects and thus cannot result in ESA take by harassment or otherwise.

7.1.4 Effects of Project Noise on Sea Turtles

Background Information – Sea Turtles and Noise
Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol and Ketten 2006, Bartol et al. 1999, Lenhardt 1994, Lenhardt 2002, Ridgway et al. 1969). Below, we summarize the available information on expected responses of sea turtles to noise.

Stress caused by acoustic exposure has not been studied for sea turtles. As described for marine mammals, a stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, it can have negative consequences to the animal such as low reproductive rates, decreased immune function, diminished foraging capacity, etc. Physiological stress is typically analyzed by measuring stress hormones (such as cortisol), other biochemical markers, and vital signs. To our knowledge, there is no direct evidence indicating that sea turtles will experience a stress response if exposed to acoustic stressors such as sounds from pile driving. However, physiological stress has been measured for sea turtles during nesting, capture and handling (Flower et al. 2015; Gregory and Schmid 2001; Jessop et al. 2003; Lance et al. 2004), and when caught in entangling nets and trawls (Hoopes et al. 2000; Snoddy et al. 2009). Therefore, based on their response to these other anthropogenic stressors, and including what is known about cetacean stress responses, we assume that some sea turtles will exhibit a stress response if exposed to a detectable sound stressor.

Marine animals often respond to anthropogenic stressors in a manner that resembles a predator response (Beale and Monaghan 2004b; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). As predators generally induce a stress response in their prey (Dwyer 2004; Lopez and Martin 2001; Mateo 2007), we assume that sea turtles may experience a stress response if exposed to acoustic stressors, especially loud sounds. We expect breeding adult females may experience a lower stress response, as studies on loggerhead, hawksbill, and green turtles have demonstrated that females appear to have a physiological mechanism to reduce or eliminate hormonal response to stress (predator attack, high temperature, and capture) in order to maintain reproductive capacity at least during their breeding season; a mechanism apparently not shared with males (Jessop 2001; Jessop et al. 2000; Jessop et al. 2004). We note that the only portion of the action area where breeding females may occur is the portion of vessel transit routes between Charleston, SC and the WDA that travel south of Virginia and that presence is limited seasonally.

Based on the limited information about acoustically induced stress responses in sea turtles, it is reasonable to assume that physiological stress responses would occur concurrently with any other response such as hearing impairment or behavioral disruptions. However, we expect such responses to be brief, with animals returning to a baseline state once exposure to the acoustic source ceases. As with cetaceans, such a short, low-level stress response may in fact be adaptive and, in part, beneficial as it may result in sea turtles exhibiting avoidance behavior, thereby minimizing their exposure duration and risk from more deleterious, high sound levels.

Effects to Hearing

Interference, or masking, occurs when a sound is a similar frequency and similar to or louder than the sound an animal is trying to hear (Clark et al. 2009b; Erbe et al. 2016). Masking can interfere with an individual's ability to gather acoustic information about its environment, such as predators, prey, conspecifics, and other environmental cues (Richardson 1995). This can result in loss of environmental cues of predatory risk, mating opportunity, or foraging options. Compared to other marine animals, such as marine mammals, which are highly adapted to use sound in the marine environment, sea turtle hearing is limited to lower frequencies and is less sensitive. Because sea turtles likely use their hearing to detect broadband low-frequency sounds in their environment, the potential for masking would be limited to certain sound exposures. Only continuous anthropogenic sounds that have a significant low-frequency component, are not of brief duration, and are of sufficient received level could create a meaningful masking situation (e.g., long-duration vibratory pile extraction or long term exposure to vessel noise affecting natural background and ambient sounds); this type of noise exposure is not anticipated based on the characteristics of the sound sources considered here.

There is evidence that sea turtles may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al. 2013), magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015), and scent (Shine et al. 2004). Thus, any effect of masking on sea turtles would likely be mediated by their normal reliance on other environmental cues.

Behavioral Responses

To date, very little research has been done regarding sea turtle behavioral responses relative to underwater noise. Popper et al. (2014) describes relative risk (high, moderate, low) for sea turtles exposed to pile driving noise and concludes that risk of a behavioral response decreases with distance from the pile being driven. O'Hara and Wilcox (1990) and McCauley et al. (2000b) experimentally examined behavioral responses of sea turtles in response to seismic airguns. O'Hara and Wilcox (1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB re: 1 µPa (rms) (or slightly less) in a shallow canal. Mccauley et al. (2000a) experimentally examined behavioral responses of sea turtles in response to seismic air guns. The authors found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB rms (re: 1 µPa), or slightly less, in a shallow canal. Mccauley et al. (2000a) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB rms (re: 1 µPa). At 175 dB rms (re: one µPa), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (Mccauley et al. 2000a). Based on these data, NMFS GARFO finds that sea turtles would exhibit a behavioral response in a manner that constitutes take by harassment, as defined for ESA take purposes above in this opinion, when exposed to received levels of 175 dB rms (re: 1 µPa) for a period long enough such that the behavioral response significantly disrupts normal behavioral patterns. This is the level at which sea turtles are expected to begin to exhibit avoidance behavior based on experimental observations of sea turtles exposed to multiple firings of nearby or approaching air guns.

7.1.4.1 Thresholds Used to Evaluate Effects of Project Noise on Sea Turtles

In order to evaluate the effects of exposure to noise by sea turtles that could result in physical effects, NMFS relies on the available literature related to the noise levels that would be expected to result in sound-induced hearing loss (i.e., TTS or PTS); we relied on acoustic thresholds for PTS and TTS for impulsive sounds developed by the U.S. Navy for Phase III of their programmatic approach to evaluating the environmental effects of their military readiness activities (U.S. Navy 2017a). At the time of this consultation, we consider these the best available data since they rely on all available information on sea turtle hearing and employ the same methodology to derive thresholds as in NMFS recently issued technical guidance for auditory injury of marine mammals (NMFS 2018). Below we briefly detail these thresholds and their derivation. More information can be found in the U.S. Navy's Technical report on the subject (U.S. Navy 2017a).

To estimate received levels from airguns and other impulsive sources expected to produce TTS in sea turtles, the U.S. Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Since these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the hearing group's composite audiogram. Based on this composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used since there are currently no data on TTS for sea turtles and fishes are considered to have hearing range more similar to sea turtles than do marine mammals (Popper et al. 2014). Assuming a similar relationship between TTS onset and PTS onset as has been described for humans and the available data on marine mammals, an extrapolation to PTS susceptibility of sea turtles was made based on the methods proposed by Navy 2017. From these data and analyses, dual metric thresholds were established similar to those for marine mammals: one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the auditory weighting function nor the duration of exposure, and another based on cumulative sound exposure level (SELcum) that incorporates both the auditory weighting function and the exposure duration (Table 7.1.22). The cumulative metric accumulates all sound exposure within a 24-hour period and is therefore different from a peak, or single exposure, metric.

Table 7.1.22. Acoustic thresholds identifying the onset of permanent threshold shift and Temporary threshold shift for sea turtles exposed to impulsive sounds (U.S. Navy 2017a)

Hearing Group	Generalized Hearing Range	Permanent Threshold Shift Onset	Temporary Threshold Shift Onset
Sea Turtles	30 Hz to 2 kHz	204 dB re: 1 Pa^2·s SEL_{cum} 232 dB re: 1 µPa SPL (0-pk)	189 dB re: 1 μPa^2·s SEL_{cum} 226 dB re: 1 µPa SPL (0-pk)

Criteria for Considering Behavioral Effects

For assessing behavioral effects, in the BA BOEM used the 175 dB re 1uPa RMS criteria based on McCauley et al. (2000b), consistent with NMFS recommendations. This level is based upon work by Mccauley et al. (2000a), who experimentally examined behavioral responses of sea turtles in response to seismic air guns. The authors found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB rms (re: 1 µPa), or slightly less, in a shallow canal. Mccauley et al. (2000a) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB rms (re: 1 µPa). At 175 dB rms (re: 1 µPa), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (Mccauley et al. 2000a). Based on these data, NMFS assumes that sea turtles would exhibit a significant behavioral response when exposed to received levels of 175 dB rms (re: 1 µPa). This is the level at which sea turtles are expected to begin to exhibit avoidance behavior based on experimental observations of sea turtles exposed to multiple firings of nearby or approaching air guns. Because data on sea turtle behavioral responses to pile driving is limited, the air gun data set is used to inform potential risk.

7.1.4.2 Effects of Project Noise on Sea Turtles

Here, we consider the effects of the noise producing activities of the Atlantic Shores project in the context of the noise thresholds presented above.

Impact Pile Driving for WTG, OSS, and Met Tower Foundation Installation

Modeling was carried out to determine distances to the onset of injury and behavioral disruption thresholds for sea turtles exposed to pile driving sound for the different piles (jacket: 5 m pre- and post-piled (with and without a 2 dB shift), and monopile: 12 m and 15 m) (Weirathmueller et al. 2023). Similar to the results presented for marine mammals, the exposure ranges (ER95%) and acoustic ranges for sea turtles were modeled assuming 10 dB broadband attenuation and a summer acoustic propagation environment (Weirathmueller et al. 2023). For the sound exposure level (SEL, cumulative exposure) criteria, acoustic energy was accumulated for all pile driving strikes in a 24 hour period. Exposure ranges vary between sea turtle species due to differences in their behavior (e.g., swim speeds, dive depths). These differences can impact both dwell time and how the animats (i.e., simulated animals) sample the sound field. As explained above, for modeled animals that have received enough acoustic energy to exceed a given threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. The resulting exposure range for each species is the 95th percentile of the CPA distances for all animals that exceeded threshold levels for that species, this is referred to as the 95 percent exposure range ($ER_{95\%}$).

Acoustic range estimates for the modeled piles and pile locations for sea turtles are included in Appendix G in Weirathmueller et al. 2023. Based on these results, noise is not expected to exceed the peak injury criteria (232 dB) during any pile driving for the Atlantic Shores project. Exposure ranges for the modeled piles and pile locations for sea turtles are included in Tables 4.5-7 to 4.5-11 in Weirathmueller et al. 2023; the tables include the distances to the cumulative injury (PTS) and behavioral disturbance thresholds. Modeling to calculate distances to the TTS threshold was not carried out. The modeling results are presented in tables 7.1.34 below.

Table 7.1.23 Exposure ranges ($ER_{95\%}$) in km to sea turtle injury threshold criteria (204 dB cSEL) and behavioral thresholds: 10 dB attenuation – 15 m monopiles (4,400 kJ hammer), one or two piles/day; 12 m monopiles (4,400 kJ hammer), one or two piles/day; 5 m pin piles (2,500 kJ hammer), four piles/day

Species	15 m monopile One/day		15 m monopile Two/day		12 m monopile One/day		12 m monopile Two/day		5 m jacket (4/day), pre-piled		5 m jacket (4/day) post-piled (2 dB shift)	
	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior
Kemp's ridley	0.02	1.31	0.04	1.28	0.02	1.24	0.03	1.23	0.02	0.50	0.03	0.72
Leatherback	0.02	1.21	0.04	1.28	0.02	0.92	0.03	1.14	0.02	0.40	0.01	0.64
loggerhead	0	1.15	0	1.10	0	0.94	0	1.01	0	0.41	0	0.58
green	0.18	1.40	0.22	1.34	0.07	1.34	0.09	1.36	0.02	0.59	0.04	0.72

Modeling was carried out to determine the numbers of individual sea turtles predicted to receive sound levels above the cumulative injury and behavioral disturbance criteria using animal movement modeling (Weirathmueller et al. 2023). Weirathmueller et al. (2023) used the JASCO Animal Simulation Model Including Noise Exposure (JASMINE) to predict the exposure of animats (virtual sea turtles) to sound arising from sound sources. An individual animat's modeled sound exposure levels are summed over the total simulation duration, such as 24 hours or the entire simulation, to determine its total received energy, and then compared to the assumed threshold criteria. The tables below include results assuming broadband attenuation of 10 dB for impact pile driving with maximum seasonal densities for each species (as described below). No aversion behaviors (e.g., avoidance) or mitigation measures (e.g., shutdown zones) other than the 10 dB attenuation for impact pile driving were incorporated into the modeling to generate the number of sea turtles of each species that are expected to be exposed to the noise.

As described in Weirathmueller et al. (2023) and in BOEM's BA, there are limited density estimates for sea turtles in the WDA. In the New York Bight, a multi-year series of seasonal aerial surveys were conducted by Normandeau Associates for the New York State Energy Research and Development Authority (NYSERDA; Normandeau Associates and APEM 2018b, 2019c, 2019a, 2019, 2020). The purpose of the aerial surveys was to gather high resolution data on marine resources within the offshore planning area (OPA) off Long Island, New York. High-resolution digital aerial photographs were collected along specific line transects each season for three consecutive years. Weirathmueller et al. (2023) used the density estimates from the NYSERDA study as a reasonable proxy for the Atlantic Shores lease area. We agree that given the geographic and habitat similarity of the Atlantic Shores lease area to the NYSERDA study area it is reasonable to expect that the density of sea turtles in the Atlantic Shores lease area would be substantially the same.

Table 7.1.24. Sea turtle density estimates for the Atlantic Shores WDA
(source: Weirathmueller et al. 2023 (table 14) Densities calculated from NYSERDA aerial survey reports, Normandeau Associates and APEM 2018b, 2019c, 2019a, 2019, 2020)

Species	Density (animals/100km^2)			
	Spring	***Summer***	***Fall***	***Winter***
Kemp's ridley sea turtle	0.050	0.991	0.190	0.000
Leatherback sea turtle	0.000	0.331	0.789	0.000
Loggerhead sea turtle	0.254	26.799	0.190	0.025
Green sea turtle [c]	0.000	0.038	0.000	0.000

As explained in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, due to seasonal water temperature patterns, sea turtles are most likely to occur in the WDA from June through October, with few sea turtles present in May, November, and early December and turtles absent in the winter months (January – April).

We considered whether sufficient information was available on detection rates from aerial surveys from which we could further adjust the exposure estimates. We reviewed the NYSERDA reports that informed the density estimates and note that they do not appear to make any adjustments to sea turtle sightings based on detectability from the survey platform. Describing an aerial survey in the MA/RI Wind Energy Area, Kraus et al. (2016) notes that the number of sea turtle sightings was substantially increased by detections in the vertical camera (mounted under the plane) compared to the number observed by observers using binoculars during the aerial survey but does not provide any information on overall sea turtle detectability nor does it adjust observations to account for availability bias. We note that the NYSERDA studies used high-resolution digital aerial photographs, which would improve detectability.

Some studies have concurrently conducted tagging studies to account for availability bias. We reviewed the literature for similar studies conducted in the lease area, however no studies were found. The closest geographic study, NEFSC 2011, estimated regional abundance of loggerhead turtles in Northwestern Atlantic Ocean continental shelf waters using aerial surveys and accounted for availability bias using satellite tags. However, as determining availability bias depends on the species and is influenced by habitat, season, sea surface temperature, time of day, and other factors, we determined that while we may be able to identify studies that identified availability bias (such as NEFSC 2011) it would not be reasonable to apply those post-hoc to the density estimates given differences in the study designs, location, habitat, sea surface temperature, etc.

We also considered whether it would be reasonable to adjust the density estimates to account for the percent of time that sea turtles are likely to be at the surface while in the WDA and therefore would be available to be detected for such a survey. However, after consulting with subject matter experts we determined it was not reasonable to adjust the density estimates with general observations about the amount of time sea turtles may be spending at the surface. Therefore, we have determined that there is no information available for us to use that could result in a different estimate of the amount of exposure that is reasonably certain to occur and have not made any further adjustments to the exposure estimates. As such, the density estimates provided in Weirathmueller et al. 2023 as derived from the cited data sources are considered the best available scientific information.

As explained above, modeling was carried out for the anticipated pile driving scenarios (i.e., one or two 12 or 15 m monopiles per day or four 5 m pin piles per day). Considering all scenarios, no sea turtles are expected to be exposed to noise above the peak injury (PTS) threshold; this is because noise during pile driving is not expected to exceed the peak injury (PTS) threshold. The tables below contain the modeled number of sea turtles predicted to be exposed to noise above the (cumulative) injury and behavioral thresholds for a construction scenario where all WTG foundations are installed with monopiles (Construction Schedule 1) and the alternative where all WTG foundations for Project 1 are monopiles and all WTG foundations for Project 2 are jacket foundations (Construction Schedule 2). These estimates do not account for any aversion behavior (i.e., avoidance of pile driving noise) and they do not incorporate the clearance or shutdown zones.

Table 7.1.25. Modeled Number of Sea Turtles Predicted to Receive Sound Levels Above Cumulative and Peak Injury and Behavioral Criteria Considering Construction Schedule 1 (all WTG monopiles for Projects 1 and 2) (source: Table 57 in BOEM's BA).

Sea Turtle Species	Individuals Exposed to Noise above the Injury (PTS) threshold		Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)
	Peak	Cumulative (24 hour)	
Kemp's ridley	0	1.96	47.13
Leatherback	0	0.95	24.42
Loggerhead	0	9.01	815.64
Green	0	0.11	1.32

Table 7.1.26. Modeled Number of Sea Turtles Predicted to Receive Sound Levels Above Cumulative and Peak Injury and Behavioral Criteria Considering Construction Schedule 2 (Project 1 WTG monopiles, Project 2 WTG jacket foundations) (source: Table 57 in BOEM's BA).

Sea Turtle Species	Individuals Exposed to Noise above the Injury (PTS) threshold		Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)
	Peak	Cumulative (24 hour)	
Kemp's ridley	0	1.96	41.60
Leatherback	0	0.76	21.67
Loggerhead	0	4.93	787.10
Green	0	0.08	1.16

In the table below we present the modeled exposures as whole numbers. We have rounded up fractions to whole animals with the exception that fractions 0.1 or less have been rounded down to zero as we consider modeled exposures at that level extremely unlikely to occur. No sea turtles are expected to be exposed to noise above the peak PTS threshold in any scenario.

Table 7.1.27. Maximum predicted exposure for each species across pile driving scenarios

Sea Turtle Species	Scenario 1 (all WTG monopiles, Project 1 and 2)		Scenario 2 (all WTG monopiles for Project 1, all WTG jacket foundations for Project 2)	
	Individuals Exposed to Noise above the Injury (PTS) threshold	Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)	Individuals Exposed to Noise above the Injury (PTS) threshold	Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)
Kemp's ridley	2	48	2	42
Leatherback	1	25	1	22
Loggerhead	9	816	5	788
Green	1	2	1	2

Proposed Measures to Minimize Exposure of Sea Turtles to Pile Driving Noise
Here, we consider the measures that are part of the proposed action, because they are proposed by Atlantic Shores or BOEM and are reflected in the proposed action as described to us by BOEM in the BA, or they are proposed to be required through the ITA (recognizing that those measures are required for marine mammals but may provide benefit to sea turtles). Specifically, we consider if and how those measures will serve to minimize exposure of ESA listed sea turtles to pile driving noise. Details of these proposed measures are included in the Description of the Action section above. We do not consider the use of PAM here; because sea turtles do not vocalize, PAM cannot be used to monitor sea turtle presence.

Seasonal Restriction on Pile Driving
No impact pile driving activities for monopiles would occur between January 1 and April 30 to avoid the time of year with the highest densities of right whales in the project area. The January 1 – April 30 period overlaps with the period when we do not expect sea turtles to occur in the action area due to cold water temperatures. This seasonal restriction is factored into the acoustic modeling that supported the development of the amount of exposure estimates above. That is, the modeling does not consider any pile driving in the January 1 – April 30 period. Thus, the exposure estimates do not need to be adjusted to account for this seasonal restriction.

Sound Attenuation Devices and Sound Field Verification
Atlantic Shores will implement sound attenuation measures that are designed and projected to achieve at least a 10 dB reduction in pile driving noise, as described above. The attainment of a 10 dB reduction in pile driving noise was incorporated into the exposure estimate calculations presented above. Thus, the exposure estimates do not need to be adjusted to account for the use of sound attenuation. If a reduction greater than 10 dB is achieved, the number of sea turtles exposed to pile driving noise could be lower as a result of smaller distances to thresholds of concern.

As described above, Atlantic Shores will conduct hydroacoustic monitoring (sound field verification) for a subset of impact-driven piles. The required sound field verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. If noise levels are higher than predicted by the modeling described here (i.e., measured distances exceed the distances to the peak and/or cumulative injury and/or behavioral disturbance thresholds identified in table 7.1.23), additional or alternative noise attenuation measures will be implemented to reduce noise and avoid exceeding the modeled distances to the injury and behavioral disturbance thresholds that were analyzed here. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than those modeled (assuming 10 dB attenuation), this would indicate the amount or extent of taking specified in the incidental take statement might be exceeded and/or constitute new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation is expected such that reinitiation of consultation would be necessary. 50 CFR 402.16.

Clearance and Shutdown Zones

BOEM will require Atlantic Shores to use PSOs to establish clearance zones of 250 m around the pile being driven to ensure the area is clear of sea turtles prior to the start of pile driving. Three PSOs will be located at an elevated location on the pile driving platform and on two vessels at a distance from the pile driving platform determined to ensure maximum detection probability of animals in the clearance and shutdown zones. Prior to the start of pile driving activity, the 250m clearance zone will be monitored for 60 minutes for protected species including sea turtles. If a sea turtle is observed approaching or entering the clearance zone prior to the start of pile driving operations, pile driving activity will be delayed until either the sea turtle has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or, 30 minutes have elapsed without re-detection of the animal. Sea turtles observed within the clearance zone will be allowed to remain in the clearance zone (*i.e.*, must leave of their own volition), and their behavior will be monitored and documented. The clearance zones may only be declared clear, and pile driving started, when the entire clearance zone is visible (*i.e.*, when not obscured by dark, rain, fog, etc.) for a full 30 minutes prior to pile driving. If a sea turtle is observed entering or within the 250 m shutdown zone after pile driving has begun, the PSO will request a temporary cessation of pile driving as explained for marine mammals above. As with marine mammals, if pile driving can not be stopped due to safety concerns, reduced hammer energy will be used.

As required by the MMPA ITA, there will be at least three PSOs stationed at an elevated position on the pile driving platform and at least three PSOs on at least two dedicated PSO vessels stationed or transiting to allow effective monitoring of the entirety of the minimum visibility (1,900 m), clearance, and shutdown zones identified in the proposed MMPA ITA. Given that PSOs at an elevated position are expected to reasonably be able to detect sea turtles at a distance of 500 m from their station, we expect that the PSOs from the pile driving platform will be able to effectively monitor the 250 m clearance zone and that the PSOs on the PSO vessels will provide additional information on sea turtles detected outside the clearance zone. While visibility of sea turtles in the clearance zone is limited to only sea turtles at or very near the surface, we expect that the monitoring the clearance zone and not starting pile driving until no sea turtles have been detected for 60 minutes will reduce the number of times that pile driving begins with a sea turtle closer than 250 m to the pile being driven. The single strike PTS (peak) threshold will not be exceeded during any impact pile driving of monopiles or pin piles; thus, injury is not expected to occur even if a sea turtle was within the clearance zone for long enough to be exposed to a single pile strike. The exposure range for the cumulative injury threshold for Kemp's ridley, leatherback, and green sea turtles is closer to the pile than the 250 m clearance and shutdown zone for all pile types; that is, the predicted closest point of approach that an individual would need to make to the pile being driven is within the area that would result in a delay or stop of pile driving (it ranges from 0 to 220 m) and is within the area that can be reliably monitored by PSOs (i.e., less than 500 m from the observation platform). As such, we expect that the clearance and shutdown requirements will reduce the potential for exposure of any individual sea turtle to noise above the injury threshold such that injury is extremely unlikely to occur. Given the modeled CPAs (0 to 220 m) and the size of the clearance zone (250 m), we would expect that given the duration of pre-start monitoring (60 minutes), a sea turtle that close to the pile would be detected by the PSO and pile driving would be delayed. During pile driving, if a sea turtle is observed within 250 m of the pile, the PSO will call for shutdown. The close approach of a sea turtle to within 220 m of the pile being driven during active pile driving is not expected due to the anticipated aversion behavior in response to the pile driving noise; therefore, we consider it extremely unlikely that any sea turtles will be exposed to noise above the cumulative injury threshold and therefore, extremely unlikely that any sea turtles will experience PTS.

Soft Start
As described above, before full energy pile driving begins, the hammer will operate at 10-20% energy for 20 minutes (440 – 880 kJ for WTG monopiles, 250-550 kJ for pin piles). At these hammer energies, underwater noise does not exceed the peak threshold for considering PTS for sea turtles; noise above the 175 dB re 1uPa threshold would extend a few hundred meters from the pile during the soft start period. The use of the soft start gives sea turtles near enough to the piles to be exposed to the soft start noise a “head start” on escape or avoidance behavior by causing them to swim away from the source. This means that sea turtles within the clearance zone that had not been detected by the PSOs would be expected to begin to swim away from the noise before full force pile driving begins; this further reduces the potential for a sea turtle remaining close enough to any pile being actively driven to experience PTS. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in behavioral disturbance. In this context, soft start is a minimization measure designed to reduce the amount and severity of effects incidental to pile driving. However, we are not able to predict the extent to which the soft start will reduce the number of sea turtles exposed to pile driving noise or the extent to which it will reduce the duration of exposure. Therefore, we are not able to modify the estimated exposures to noise above the behavioral disturbance threshold to account for any benefit provided by the soft start.

7.1.4.1 Effects to Sea Turtles Exposed to Impact Pile Driving Noise for Foundation Installation
As noted above, modeling indicates that noise above the peak PTS threshold is not exceeded in any pile driving scenario. Acoustic modeling indicates that exposure to noise above the cumulative PTS threshold is expected to occur at a distance (0-220 m) that is smaller than the clearance and shutdown zone (250 m) for loggerhead, Kemp’s ridley, leatherback, and green sea turtles (Table 7.1.23; ER95% in km to sea turtle injury threshold criteria (204 dB cSEL) are less than 250 m for all species and pile types). These distances are the “closest point of approach”; that is, based on animat modeling that factors in species specific behavior (but not aversion from the noise source), an individual turtle needs to get at least that close to the pile for it to have accumulated enough acoustic energy to experience PTS. As explained above, depending on species and pile type these distances range from 0 to 220 m from the pile, which is within the 250 m clearance and shutdown zone. The exposure analysis conducted by Weirathmueller et al. (2023) predicts exposure of up to 1.96 Kemp’s ridley, 0.95 leatherback, 9.01 loggerhead, and 0.11 green sea turtle to noise above the cumulative PTS threshold (dependent on construction schedule). As explained above, given that the closest point of approach for all species (no greater than 220 m across all pile types, construction scenarios, and species, Table 7.1.23), is less than the 250 m clearance and shutdown zone, we expect exposure to noise that could result in PTS to be extremely unlikely to occur. Given this, and considering that the modeling did not incorporate aversion behavior which we expect will result in sea turtles avoiding noise above the behavioral harassment threshold (which will extend further from the pile than the estimated “closest point of approach”), we consider it extremely unlikely that any sea turtles will be

exposed to pile driving noise that could result in PTS. Therefore, no PTS or other injury is anticipated to occur as a result of exposure to pile driving noise.

The exposure analysis also predicts exposure of sea turtles to noise expected to result in a behavioral response. As noted above, considering the different proposed construction schedules, and rounding anything greater than 0.1 up to a whole number, modeling predicts the exposure of up to 48 Kemp's ridleys, 25 leatherbacks, 816 loggerheads, and 2 green sea turtle will be exposed to noise above the behavioral impacts threshold (Tables 7.1.37; with lower numbers if project 2 uses jackets for WTG foundations instead of monopile foundations). Neither Atlantic Shores nor BOEM modeled the number of sea turtles expected to be exposed to noise above the TTS threshold. It is reasonable to assume that some of the sea turtles exposed to noise above the 175 dB threshold but below the PTS threshold would also be exposed to noise above the cumulative TTS threshold. As we have no means of estimating the proportion of these turtles that would experience TTS, we have considered that all of these turtles may also experience TTS; this is consistent with BOEM's analysis presented in the BA.

Any sea turtles affected by TTS would experience a temporary, recoverable, hearing loss manifested as a threshold shift around the frequency of the pile driving noise. Because sea turtles do not use noise to communicate, any TTS would not impact communications. We expect that this temporary hearing impairment could affect frequencies utilized by sea turtles for acoustic cues such as the sound of waves, coastline noise, or the presence of a vessel or predator. Sea turtles are not known to depend heavily on acoustic cues for vital biological functions (Nelms et al. 2016; Popper et al. 2014), and instead, may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al. 2013) and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). As such, it is unlikely that the temporary loss of hearing sensitivity in a sea turtle would affect its fitness (i.e., survival or reproduction). That said, it is possible that sea turtles use acoustic cues such as waves crashing, wind, vessel and/or predator noise to perceive the environment around them. If such cues increase survivorship (e.g., aid in avoiding predators, navigation), temporary loss of hearing sensitivity may have effects on individual sea turtle fitness. TTS of sea turtles is expected to only last for several days following the initial exposure (Moein et al. 1994). Given this short period of time, and that sea turtles are not known to rely heavily on acoustic cues, while TTS may impact the ability of affected individuals to avoid threats during the few days that TTS is experienced, we do not anticipate single TTSs would have any longterm impacts on the health or reproductive capacity or success of individual sea turtles; TTS is considered in the context of the ESA definition of harassment below.

Masking

Sea turtle hearing abilities and known use of sound to detect environmental cues is discussed above. Sea turtles are thought capable of detecting nearby broadband sounds, such as would be produced by pile driving. Thus, environmental sounds, such as the sounds of waves crashing along coastal beaches or other important cues for sea turtles, could possibly be masked for a short duration during pile driving. However, any masking would not persist beyond the period a sea turtle is exposed to the pile driving noise (likely minutes but in no case more than the approximately 7 to 9 hours it takes to drive a single monopile or up to 3 hours to drive a single pin pile. As addressed in Hazel et al. (2004), sea turtle reaction to vessels is thought to be based on visual cues and not sound; thus, we do not expect that any masking would increase the risk of vessel strike as sea turtles are not expected to rely on the noise of vessels to avoid vessels.

Behavioral Response and Stress
Based on prior observations of sea turtle reactions to sound, if a behavioral reaction were to occur, the responses could include increases in swim speed, change of position in the water column, or avoidance of the sound. The area where pile driving will occur is not known to be a breeding area and is over 200 km north of the nearest beach where sea turtle nesting has been documented (Virginia Beach, VA). Therefore, breeding adults and hatchlings are not expected in the area. The expected behavioral reactions would temporarily disrupt migration, feeding, or resting. However, that disruption will last for no longer than it takes the sea turtle to swim away from the noisy area (less than 2 km) and displacement from a particular areas would last, at the longest, the duration of pile driving (up to 9 hours for a monopile, 3 hours for a pin pile). There is no evidence to suggest that any behavioral response would persist beyond the duration of the sound exposure, which in this case is the time it takes the turtle to swim less than 2 km or the time to drive a pile, approximately 3 to 9 hours, depending on pile type. For migrating sea turtles, it is unlikely that this temporary disturbance, which would result in a change in swimming direction, would have any consequence to the animal. Resting sea turtles are expected to resume resting once they escape the noise. Foraging sea turtles would resume foraging once suitable forage is located outside the noisy area.

While in some instances, temporary displacement from an area may have significant consequences to individuals or populations this is not the case here. For example, if individual turtles were prevented from accessing nesting beaches and missed a nesting cue or were precluded from a foraging area for an extensive period, there could be impacts to reproduction and the health of individuals, respectively. However, the area where noise may be at disturbing levels at any one time is an extremely small portion of the coastal area used for north-south and south-north migrations and is only a fraction of the WDA used by foraging sea turtles. We have no information to indicate that any particular portion of the WDA is more valuable to sea turtles than another and no information to indicate that resting, foraging and migrating cannot take place in any portion of the WDA or that any area is better suited for these activities than any other area. A disruption in migration, feeding, or resting for no more than the period the animal is exposed to pile driving noise (up to 3 to 9 hours and likely even less given the short distance a sea turtle would need to swim to avoid the noise), is not expected to result in any reduction in the health or fitness of any sea turtle. Additionally, significant behavioral responses that result in disruption of important life functions are more likely to occur from multiple exposures within a longer period of time, which are not expected to occur during the pile driving operations for the Atlantic Shores project as the impact pile driving noise will be intermittent and temporary.

Concurrent with the above responses, sea turtles are also expected to experience physiological stress responses. Stress is an adaptive response and does not normally place an animal at risk. Distress involves a chronic stress response resulting in a negative biological consequence to the individual. While all ESA-listed sea turtles that experience TTS and behavioral responses are also expected to experience a stress response, such responses are expected to be short-term in nature given the duration of pile driving (no more than 9 hours at a time) and because we do not expect any sea turtles to be exposed to pile driving noise on more than one day. As such, we do not anticipate stress responses would be chronic, involve distress, or have negative long-term impacts on any individual sea turtle's fitness.

All behavioral responses to a disturbance, such as those described above, will have an energetic or metabolic consequence to the individual reacting to the disturbance (e.g., adjustments in migratory movements or disruption/delays in foraging or resting). Short-term interruptions of normal behavior are likely to have little effect on the overall health, reproduction, and energy balance of an individual or population (Richardson *et al.* 1995). As the disturbance will occur for a portion of each day for a period of up to approximately 124 days in year 1 of foundation pile driving and up to 107 days in year 2, with pile driving occurring for no more than approximately 12 hours per day, this exposure and displacement will be temporary and not chronic. Therefore, any interruptions in behavior and associated metabolic or energetic consequences will similarly be temporary. Thus, we do not anticipate any impairment of the overall health, survivability, or reproduction of any individual sea turtle due to avoidance or displacement resulting from exposure to pile driving noise.

As explained above, we do not expect masking to increase the risk of vessel strike as sea turtles are expected to rely on visual, rather than acoustic, cues when attempting to avoid vessels. We have considered if the avoidance of pile driving noise is likely to result in an increased risk of vessel strike or entanglement in fishing gear. This could theoretically occur if displacement from an area ensonified by pile driving noise resulted in individuals moving into areas where vessel traffic was higher or where fishing gear was more abundant. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that a sea turtle is expected to avoid (no more than 1.5 km from the pile being installed), the short term nature of any disturbance, the limited number of sea turtles impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 1.5 km area that would put a sea turtle at greater risk of vessel strike or entanglement/capture.

We evaluate the potential for noise produced by the proposed action to cause ESA take by harassment. As explained above, the NMFS Interim Guidance on the ESA Term "Harass" (NMFS PD-02-111-XX) provides for a four-step process to determine if a response meets the definition of harassment. Here, we carry out that four-step assessment to determine if the effects to the up to 48 Kemp's ridley, 25 leatherback, 816 loggerhead, and 2 green sea turtles expected to be exposed to noise above the 175 dB threshold but below the injury threshold meet the definition of harassment. We have established that up to 48 Kemp's ridley, 25 leatherback, 816 loggerhead, and 2 green sea turtles will be exposed to disturbing levels of noise (step 1). For an individual, the nature of this exposure is expected to be limited to a one-time exposure to pile driving noise and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the pile driving event (up to 9 hours for a monopile and up to 3 hours for a pin pile); this disruption will occur in areas where individuals may be migrating, foraging, or resting (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the 175 dB threshold (traveling up to 1.5 km). As explained above, these individuals are expected to experience TTS (temporary hearing impairment), masking (which, together with TTS would affect their ability to detect certain environmental cues which may include predators and other threats), stress, disruptions to foraging, resting, or migrating and energetic consequences of moving away from the pile driving noise and potentially needing to seek out alternative prey resources (step 3). Together, these effects will significantly disrupt a sea turtle's normal behavior at a level that creates the likelihood of injury for the duration of exposure to pile driving and the period before TTS resolves (i.e., when hearing sensitivity returns to normal); that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the up to 48 Kemp's ridley, 25 leatherback, 816 loggerhead, and 2 green sea turtle exposed to pile driving noise louder than 175 dB re 1uPa rms and experience TTS are likely to be adversely affected and that effect amounts to harassment. As such, we expect the harassment of up to 48 Kemp's ridley, 25 leatherback, 816 loggerhead, and 2 green sea turtles 1 as a result of exposure to foundation pile driving noise.

NMFS defines "harm" in the definition of ESA "take" as "an act which actually kills or injures fish or wildlife (50 CFR 222.102). Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). Here, we consider if the sea turtles that will experience TTS and behavioral disruption that met the definition of harassment will also be harmed. No sea turtles will be injured or killed due to this exposure to pile driving noise. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual sea turtles on the day that the turtle is exposed to the pile driving noise and the period that TTS is experienced, creating the likelihood of injury by potentially reducing response time to threats, it will not actually kill or injure any sea turtles directly or by significantly impairing any essential behavioral patterns. We do not expect TTS, stress, or behavioral disturbance to result in an animal not being able to detect and avoid a threat in a way that results in injury. Stress effects will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in breeding or nesting. TTS will resolve within no more than a week of exposure and is not expected to affect the health of any turtle or its ability to migrate, forage, breed, or nest. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to migrate, forage, breed, or nest. Thus, as no injury or mortality will actually occur, the response of individual sea turtles to pile driving noise does not meet the definition of "harm."

Vibratory Pile Driving for Sheet Pile Installation and Removal
In the BA, BOEM presents information on the anticipated sound levels from cofferdam installation and removal in consideration of the identified sea turtle thresholds. As noted in the BA, based on the typical sound levels for vibratory pile driving (L_E < 190 dB) reported by Hart Crowser and Illingworth and Rodkin (2009), vibratory pile driving noise is extremely unlikely to

exceed PTS thresholds for sea turtles. As explained above, sound measurements by Illingworth and Rodkin (2017) were used to model sound propagation of vibratory pile driving of the installation and removal of cofferdam sheet piles for marine mammals. The maximum root mean squared sound pressure level (L_{rms}) for vibratory pile driving was 170 dB re 1 µPa at 32.8 feet (10 meters) from the source. Inputting this information into the NMFS Multi-Species Pile Driving Calculator indicates that noise would exceed the behavioral threshold at a distance of less than 5 m from the pile. Given the requirement to not start pile driving until an area extending at least 10 m from the pile is clear of sea turtles and the requirement to shut down if a sea turtle occurs within 10 m of the pile, it is extremely unlikely that any sea turtles will be exposed to noise that is expected to result in a behavioral response. Therefore, it is extremely unlikely that sea turtles would be exposed to sound levels that would result in behavioral disturbance and effects are discountable. No take of any sea turtles is expected to result from exposure to noise resulting from pile driving for the installation or removal sheet piles to support cofferdam installation.

As part of the Connected Action, an existing sheet pile bulkhead located within an existing marina basin at Atlantic City will be repaired/rehabilitated through the installation of approximately 356 linear feet of steel or vinyl sheet piles with a vibratory hammer. The schedule (13 to 14 48" piles per day) is expected to be similar to installation of piles for the cofferdams. As with those piles, noise is not expected to exceed the sea turtle injury thresholds and would be above the behavioral threshold only within 5 m of the pile. No clearance or shutdown zone has been proposed for the piles at the Atlantic City O&M facility. However, given the location of the bulkhead in an existing marina basin where few, if any sea turtles are expected to occur, the extremely small area where noise will be above the behavioral threshold, and the short duration of pile installation (estimated at no more than 7 days), it is extremely unlikely that any sea turtles would be exposed to noise that is expected to result in a behavioral response and effects are discountable. No take of any sea turtles is expected to result from exposure to noise resulting from pile driving for the sheet piles to support bulkhead rehabilitation.

Operation of WTGs

As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and may not be representative of newer direct-drive WTGs, like those that will be installed for the Atlantic Shores project. Elliot et al. (2019) reports underwater noise monitoring at the Block Island Wind Farm, which has direct-drive GE Haliade turbines; as explained in section 7.1.2, this, combined with information from HDR 2023 from monitoring of operational noise from the 2 CVOW 12 MW direct drive turbines, is the best available data for estimating operational noise of the Atlantic Shores turbines. The loudest noise recorded in Eliot et al. was 126 dB re 1uPa at a distance of 50 m from the turbine when wind speeds exceeded 56 kmh. HDR 2023 reports noise between 120 and 130 dB within 350 m of the monopile foundation, with the exception of noise to 145 dB during stoms. As noted above, based on wind speed records within the WDA (Atlantic Shores COP) and the nearby Ambrose Buoy, the annual maximum wind speed (10-minute average) is 50.3 mph in the WDA and instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, with wind speeds exceeding 40 km/h less than 3% of the time across a year.

Elliot et al. (2019) conclude that based on monitoring of underwater noise at the Block Island site, under maximum potential impact scenarios, no risk of temporary or permanent hearing damage (PTS or TTS) for sea turtles could be projected even if an animal remained in the water at 50 m (164 ft.) from the turbine for a full 24-hour period. Based on the results reported by HDR 2023, we would reach a similar conclusion. As underwater noise anticipated from the operation of the WTGs, based on Eliot et al. 2019 and HDR 2023, is expected to be below the thresholds for considering behavioral disturbance for sea turtles, and considering that there is no potential for exposure to noise above the peak or cumulative PTS or TTS thresholds, effects to sea turtles exposed to noise associated with the operating turbines are extremely unlikely to occur. No take of sea turtles from exposure to operational noise is expected.

HRG Surveys

Some of the equipment that is proposed for use for HRG surveys produces underwater noise that can be perceived by sea turtles; for the equipment described by Atlantic Shores this is limited to CHRIP and sparkers. Extensive information on HRG survey noise and potential effects of exposure to sea turtles is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021). We summarize the relevant conclusions here. The maximum distance to the 175 dB re 1uPa behavioral disturbance threshold is 90 meters; the TTS and PTS thresholds are not exceeded at any distance (see table 7.1.28).

Table 7.1.28 Largest PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots –Sea Turtles

HRG SOURCE	Highest Source Level (dB re 1 µPa)	Sea Turtle Onset of Injury Threshold		Sea Turtle Behavior (175 dB re 1uPa rms)
		Peak	*SEL*	
Boomers	176 dB SEL 207 dB RMS 216 PEAK	0	0	40
Sparkers	188 dB SEL 214 dB RMS 225 PEAK	0	0	90
Chirp Sub-Bottom Profilers	193 dB SEL 209 dB RMS 214 PEAK	NA	NA	2
Multi-beam echosounder (100 kHz)	185 dB SEL 224 dB RMS 228 PEAK	NA	NA	NA
	182 dB SEL	NA	NA	NA

Multi-beam echosounder (>200 kHz) (mobile, non-impulsive, intermittent)	218 dB RMS 223 PEAK			
Side-scan sonar (>200 kHz) (mobile, non-impulsive, intermittent)	184 dB SEL 220 dB RMS 226 PEAK	NA	NA	NA

Sea turtle PTS distances were calculated for 203 cSEL and 230 dB peak criteria from Navy (2017).
NA = not applicable due to the sound source being out of the hearing range for the group.

None of the equipment being operated for these surveys that overlaps with the hearing range (30 Hz to 2 kHz) for sea turtles has source levels loud enough to result in PTS or TTS based on the peak or cumulative exposure criteria. Therefore, physical effects are extremely unlikely to occur.

As explained above, we find that sea turtles would exhibit a behavioral response when exposed to received levels of 175 dB re: 1 µPa (rms) and are within their hearing range (below 2 kHz). The distance to this threshold is 90 m for sparkers, 40 m for boomers, and 2 m for chirps (Table 7.1.28). Thus, a sea turtle would need to be within 90 m of the source to be exposed to potentially disturbing levels of noise. We expect that sea turtles would react to this exposure by swimming away from the sound source; this would limit exposure to a short time period, just the few seconds it would take an individual to swim away to avoid the noise. As the noise source is moving, this further limits the potential for exposure that would result in sustained behavioral disturbance and we expect exposure to be limited to only seconds to minutes. BOEM calculated that for a survey with equipment being towed at 3 knots, exposure of a turtle that was within 90 m of the source would last for less than two minutes.

The risk of exposure to potentially disturbing levels of noise is reduced by the use of PSOs to monitor for sea turtles. A clearance zone (500 m in all directions) for ESA-listed species must be monitored around all vessels operating equipment at a frequency of less than 180 kHz. At the start of a survey, equipment cannot be turned on until the Clearance Zone is clear for at least 30 minutes. This condition is expected to reduce the potential for sea turtles to be exposed to noise that may be disturbing. However, even in the event that a sea turtle is submerged and not seen by the PSO, in the worst case, we expect that sea turtles would avoid the area ensonified by the survey equipment that they can perceive. Because the area where increased underwater noise will be experienced is transient and increased underwater noise will only be experienced in a particular area for less than two minutes, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging or migrations are disrupted, we expect that they will quickly resume once the survey vessel has left the area. No sea turtles will be displaced from a particular area for more than a few minutes. While the movements of individual sea turtles will be affected by the sound associated with the survey, these effects will be temporary (no more than two minutes) and localized (avoiding an area no larger than 90 m) and there will be only a minor and temporary impact on foraging, migrating, or resting sea turtles. For example, BOEM calculated that for a survey with equipment being towed at 3 knots, exposure of a sea turtle that was within 90 m of the source would last for less than two minutes.

Given the intermittent and short duration of exposure to any potentially disturbing noise from HRG equipment, effects to individual sea turtles from brief exposure to potentially disturbing levels of noise are expected to be minor and limited to a brief startle, short increase in swimming speed and/or short displacement from an area not exceeding 90 m in diameter. As effects will be so small that they cannot be meaningfully measured, detected, or evaluated, effects are insignificant, and take is not anticipated to occur.

7.1.5. Effects of Project Noise on Sturgeon

Background Information – Sturgeon and Noise

Impulsive sounds such as those produced by impact pile driving can affect fish in a variety of ways, and in certain circumstances, can cause mortality, auditory injury, barotrauma, and behavioral changes. Impulsive sound sources produce brief, broadband signals that are atonal transients (e.g., high amplitude, short-duration sound at the beginning of a waveform; not a continuous waveform). They are generally characterized by a rapid rise from ambient sound pressures to a maximal pressure followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures. For these reasons, they generally have an increased capacity to induce physical injuries in fishes, especially those with swim bladders (Casper et al. 2013a; Halvorsen et al. 2012b; Popper et al. 2014). These types of sound pressures cause the swim bladder in a fish to rapidly and repeatedly expand and contract, and pound against the internal organs. This pneumatic pounding may result in hemorrhage and rupture of blood vessels and internal organs, including the swim bladder, spleen, liver, and kidneys. External damage has also been documented, evident with loss of scales, hematomas in the eyes, base of fins, etc. (e.g., Casper et al. 2012c; Gisiner 1998; Halvorsen et al. 2012b; Wiley et al. 1981; Yelverton et al. 1975a). Fish can survive and recover from some injuries, but in other cases, death can be instantaneous, occur within minutes after exposure, or occur several days later.

Hearing impairment

Research is limited on the effects of impulsive noise on the hearing of fishes, however some research on seismic air gun exposure has demonstrated mortality and potential damage to the lateral line cells in fish larvae, fry, and embryos after exposure to single shots from a seismic air gun near the source (0.01 to 6 m; Booman et al. 1996; Cox et al. 2012). Popper et al. (2005a) examined the effects of a seismic air gun array on a fish with hearing specializations, the lake chub (*Couesius plumbeus*), and two species that lack notable hearing specializations, the northern pike (*Esox lucius*) and the broad whitefish (*Coregonus nasus*), a salmonid species. In this study, the average received exposure levels were a mean peak pressure level of 207 dB re 1 μPa; sound pressure level of 197 dB re 1 μPa; and single-shot sound exposure level of 177 dB re 1 μPa^2-s. The results showed temporary hearing loss for both lake chub and northern pike to both 5 and 20 air gun shots, but not for the broad whitefish. Hearing loss was approximately 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18-24 hours after sound exposure. Examination of the sensory surfaces showed no damage to sensory hair cells in any of the fish from these exposures (Song et al. 2008). Popper et al. (2006) also indicated exposure of adult fish to a single shot from an air gun array (consisting of four air guns) within close range (six meters) did not result in any signs of mortality, seven days post-exposure. Although non-lethal injuries were observed, the researchers could not attribute them to air gun exposure as similar injuries were observed in controlled fishes. Other studies conducted on fishes with swim bladders did not show any mortality or evidence of other injury (Hastings et al. 2008; McCauley and Kent 2012; Popper et al. 2014; Popper et al. 2007; Popper et al. 2005a).

McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the inner ear of the pink snapper (*Pagrus auratus*) exposed to a moving air gun array for 1.5 hours. Maximum received levels exceeded 180 dB re 1 μPa^2-s for a few shots. The loss of sensory hair cells continued to increase for up to at least 58 days post-exposure to 2.7 percent of the total cells. It is not known if this hair cell loss would result in hearing loss since TTS was not examined. Therefore, it remains unclear why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005a) did not. However, there are many differences between the studies, including species, precise sound source, and spectrum of the sound that make it difficult speculate what caused the hair cell damage in one study and not the other.

Hastings et al. (2008) exposed the pinecone soldierfish (*Myripristis murdjan*), a fish with anatomical specializations to enhance their hearing and three species without notable specializations: the blue green damselfish (*Chromis viridis*), the saber squirrelfish (*Sargocentron spiniferum*), and the bluestripe seaperch (*Lutjanus kasmira*) to an air gun array. Fish in cages in 16 ft. (4.9 m) of water were exposed to multiple air gun shots with a cumulative sound exposure level of 190 dB re 1 μPa^2-s. The authors found no hearing loss in any fish following exposures. Based on the tests to date that indicated TTS in fishes from exposure to impulsive sound sources (air guns and pile driving) the recommended threshold for the onset of TTS in fishes is 186 dB SEL_{cum} re 1 μPa^2-s, as described in the 2014 *ANSI Guidelines*.

Physiological Stress

Physiological effects to fishes from exposure to anthropogenic sound are increases in stress hormones or changes to other biochemical stress indicators (e.g., D'amelio et al. 1999; Sverdrup et al. 1994; Wysocki et al. 2006). Fishes may have physiological stress reactions to sounds that they can detect. For example, a sudden increase in sound pressure level or an increase in overall background noise levels can increase hormone levels and alter other metabolic rates indicative of a stress response. Studies have demonstrated elevated hormones such as cortisol, or increased ventilation and oxygen consumption (Hastings and C. 2009; Pickering 1981; Simpson et al. 2015; Simpson et al. 2016; Smith et al. 2004a; Smith et al. 2004b). Although results from these studies have varied, it has been shown that chronic or long-term (days or weeks) exposures of continuous anthropogenic sounds can lead to a reduction in embryo viability (Sierra-Flores et al. 2015) and decreased growth rates (Nedelec et al. 2015).

Generally, stress responses are more likely to occur in the presence of potentially threatening sound sources such as predator vocalizations or the sudden onset of loud and impulsive sound signals. Stress responses are typically considered brief (a few seconds to minutes) if the exposure is short or if fishes habituate or have previous experience with the sound**.** However, exposure to chronic noise sources may lead to more severe effects leading to fitness consequences such as reduced growth rates, decreased survival rates, reduced foraging success, etc. Although physiological stress responses may not be detectable on fishes during sound exposures, NMFS assumes a stress response occurs when other physiological impacts such as injury or hearing loss occur.

Some studies have been conducted that measure changes in cortisol levels in response to sound sources. Cortisol levels have been measured in fishes exposed to vessel noises, predator vocalizations, or other tones during playback experiments**.** Nichols et al. (2015a) exposed giant kelpfish (*Heterostichus rostratus*) to vessel playback sounds, and fish increased levels of cortisol were found with increased sound levels and intermittency of the playbacks. Sierra-Flores et al. (2015) demonstrated increased cortisol levels in fishes exposed to a short duration upsweep (a tone that sweeps upward across multiple frequencies) across 100 to 1,000 Hz. The levels returned to normal within one hour post-exposure, which supports the general assumption that spikes in stress hormones generally return to normal once the sound of concern ceases**.** Gulf toadfish (*Opsanus beta*) were found to have elevated cortisol levels when exposed to low-frequency dolphin vocalization playbacks (Remage-Healey et al. 2006). Interestingly, the researchers observed none of these effects in toadfish exposed to low frequency snapping shrimp "pops," indicating what sound the fish may detect and perceive as threats. Not all research has indicated stress responses resulting in increased hormone levels. Goldfish exposed to continuous (0.1 to 10 kHz) sound at a pressure level of 170 dB re 1 µPa for one month showed no increase in stress hormones (Smith et al. 2004b). Similarly, Wysocki et al. (2007b) exposed rainbow trout to continuous band-limited noise with a sound pressure level of about 150 dB re 1 µPa for nine months with no observed stress effects. Additionally, the researchers found no significant changes to growth rates or immune systems compared to control animals held at a sound pressure level of 110 dB re 1 µPa.

Masking

As described previously in this biological opinion, masking generally results from a sound impeding an animal's ability to hear other sounds of interest. The frequency of the received level and duration of the sound exposure determine the potential degree of auditory masking. Similar to hearing loss, the greater the degree of masking, the smaller the area becomes within which an animal can detect biologically relevant sounds such as those required to attract mates, avoid predators or find prey (Slabbekoorn et al. 2010). Because the ability to detect and process sound may be important for fish survival, anything that may significantly prevent or affect the ability of fish to detect, process or otherwise recognize a biologically or ecologically relevant sound could decrease chances of survival. For example, some studies on anthropogenic sound effects on fishes have shown that the temporal pattern of fish vocalizations (e.g., sciaenids and gobies) may be altered when fish are exposed to sound-masking (Parsons et al. 2009). This may indicate fish are able to react to noisy environments by exploiting "quiet windows" (e.g., Lugli and Fine 2003) or moving from affected areas and congregating in areas less disturbed by nuisance sound sources. In some cases, vocal compensations occur, such as increases in the number of individuals vocalizing in the area, or increases in the pulse/sound rates produced (Picciulin et al. 2012). Fish vocal compensations could have an energetic cost to the individual, which may lead to a fitness consequence such as affecting their reproductive success or increase detection by predators (Amorin et al. 2002; Bonacito et al. 2001).

Behavioral Responses

In general, NMFS assumes that most fish species would respond in similar manner to both air guns and impact pile driving. As with explosives, these reactions could include startle or alarm responses, quick bursts in swimming speeds, diving, or changes in swimming orientation. In other responses, fish may move from the area or stay and try to hide if they perceive the sound as a potential threat. Other potential changes include reduced predator awareness and reduced feeding effort. The potential for adverse behavioral effects will depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, as well as life stages of fish that are present in the areas affected.

Fish that detect an impulsive sound may respond in "alarm" detected by Fewtrell (2003), or other startle responses may also be exhibited. The startle response in fishes is a quick burst of swimming that may be involved in avoidance of predators. A fish that exhibits a startle response may not necessarily be injured, but it is exhibiting behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment. However, fish do not exhibit a startle response every time they experience a strong hydroacoustic stimulus. A study in Puget Sound, Washington suggests that pile driving operations disrupt juvenile salmon behavior (Feist et al. 1992). Though no underwater sound measurements are available from that study, comparisons between juvenile salmon schooling behavior in areas subjected to pile driving/construction and other areas where there was no pile driving/construction indicate that there were fewer schools of fish in the pile-driving areas than in the non-pile driving areas. The results are not conclusive but there is a suggestion that pile-driving operations may result in a disruption in the normal migratory behavior of the salmon in that study, though the mechanisms salmon may use for avoiding the area are not understood at this time.

Because of the inherent difficulties with conducting fish behavioral studies in the wild, data on behavioral responses for fishes is largely limited to caged or confined fish studies, mostly limited to studies using caged fishes and the use of seismic air guns (Lokkeberg et al. 2012). In an effort to assess potential fish responses to anthropogenic sound, NMFS has historically applied an interim criteria for onset injury of fish from impact pile driving which was agreed to in 2008 by a coalition of federal and non-federal agencies along the West Coast (FHWG 2008). These criteria were also discussed in Stadler and Woodbury (2009), wherein the onset of physical injury for fishes would be expected if either the peak sound pressure level exceeds 206 dB (re 1 μPa), or the SEL_{cum}, (re 1 μPa^2-s) accumulated over all pile strikes occurring within a single day, exceeds 187 dB SEL_{cum} (re 1 μPa^2-s) for fish two grams or larger, or 183 dB re 1 μPa^2-s for fishes less than two grams. The more recent recommendations from the studies conducted by Halvorsen et al. (2011a), Halvorsen et al. (2012b), and Casper et al. (2012c), and summarized in the 2014 *ANSI Guidelines* are similar to these levels, but also establishes levels based upon fish hearing abilities, the presence of a swim bladder as well as severity of effects ranging from mortality, recoverable injury to TTS. The interim criteria developed in 2008 were developed primarily from air gun and explosive effects on fishes (and some pile driving) because limited information regarding impact pile driving effects on fishes was available at the time.

7.1.5.1. Criteria Used for Assessing Effects of Noise Exposure to Sturgeon

There is no available information on the hearing capabilities of Atlantic sturgeon specifically, although the hearing of two other species of sturgeon have been studied. While sturgeon have swimbladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon (*Acipenser sturio*) using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon (*Acipenser fulvescens*) and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for oscar (*Astronotus ocellatus*) and goldfish (*Carassius auratus*) and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (that can hear up to 5 kHz) than to the oscar (that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002). Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of all Atlantic sturgeon DPSs.

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, FHWA, USACE, and the California, Washington and Oregon DOTs, supported by national experts on underwater sound producing activities that affect fish and wildlife species of concern. In June 2008, the agencies signed an MOA documenting criteria for assessing physiological effects of impact pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted that these criteria are for the onset of physiological effects (Stadler and Woodbury, 2009), not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all fish species, including listed green sturgeon, which are biologically similar to shortnose and Atlantic sturgeon and for these purposes can be considered a surrogate. The interim criteria are:

- Peak SPL: 206 dB re 1 µPa
- SELcum: 187 dB re 1µPa^2-s for fishes 2 grams or larger (0.07 ounces).
- SELcum: 183 dB re 1µPa^2-s for fishes less than 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to sturgeon are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

Popper et al. (2014) presents a series of proposed thresholds for onset of mortality and potential injury, recoverable injury, and temporary threshold shift for fish species exposed to pile driving noise. This assessment incorporates information from lake sturgeon and includes a category for fish that have a swim bladder that is not involved in hearing (such as Atlantic sturgeon). The criteria included in Popper et al. (2014) are:

- Mortality and potential mortal injury: 210 dB SELcum or >207 dB peak
- Recoverable injury: 203 dB SELcum or >207 dB peak
- TTS: >186 dB SELcum.

While these criteria are not exactly the same as the FHWG criteria, they are very similar. Based on the available information, for the purposes of this Opinion, we consider the potential for physiological effects upon exposure to 206 dB re 1 µPa peak and 187 dB re 1 µPa^2-s cSEL. Use of the 183 dB re 1 µPa^2-s cSEL threshold is not appropriate for this consultation because all sturgeon in the action area will be larger than 2 grams. Physiological effects could range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

We use 150 dB re: 1 µPa RMS as a threshold for examining the potential for behavioral responses by individual listed fish to noise with frequency less than 1 kHz. This is supported by information provided in a number of studies described above (Andersson et al. 2007, Purser and Radford 2011, Wysocki et al. 2007). Responses to temporary exposure of noise of this level is expected to be a range of responses indicating that a fish detects the sound, these can be brief startle responses or, in the worst case, we expect that listed fish would completely avoid the area ensonified above 150 dB re: 1 uPa rms. Popper et al. (2014) does not identify a behavioral threshold but notes that the potential for behavioral disturbance decreases with the distance from the source.

7.1.5.2 Effects to Atlantic Sturgeon Exposed to Project Noise

Impact Pile Driving for WTG, OSS, and Met Tower Foundations

Distances to potential injury and behavioral disruption thresholds for fish exposed to pile driving sound for the different piles (jacket: 5 m with and without a 2 dB shift, and monopile: 12 m and 15 m) were modeled (Weirathmueller et al. 2023). The acoustic ranges ($R_{95\%}$) to fish impact criteria thresholds (i.e., onset of injury and behavioral disturbance) were calculated by determining the isopleth at which thresholds could be exceeded (Weirathmueller et al. 2023) considering 0, 6, 10, and 15 dB attenuation; as requirements for achieving 10 dB attenuation are part of the proposed action, those results are presented here and form the basis for our effects analysis. For the sound exposure level (SEL, cumulative exposure) criteria, acoustic energy was accumulated for all pile driving strikes in a 24 hour period. Acoustic range estimates for the modeled piles and pile locations for fish are included in Tables 42-44 and F-93 to F-104 in Weirathmueller et al. 2023 (COP Appendix II-L). The distances to the identified criteria for the different pile types is summarized in the table below.

Table 7.1.29 Acoustic range (R95%) in km to sturgeon threshold criteria with 10 dB attenuation. The largest modeled distances and maximum hammer energy (4,400 kJ for monopiles and 2,500 kJ for jackets) are shown.

	12 m monopile	15 m monopile	5 m jacket	5 m jacket (with 2 dB shift)
peak injury (206)	0.150	0.110	0.04	0.05
cumulative injury (187)	5.57	5.99	5.72	6.45
behavior (150)	7.12	7.23	4.31	4.9

No density estimates for Atlantic sturgeon are available for the action area or for any area that could be used to estimate density in the action area. Therefore, it was not possible to conduct an exposure analysis to predict the number of Atlantic sturgeon likely to be exposed to any of the thresholds identified here.

Consideration of Mitigation Measures
Here, we consider the measures that are part of the proposed action, either because they are proposed by Atlantic Shores or by BOEM and reflected in the proposed action as described to us by BOEM in the BA, or are proposed to be required through the MMPA ITA. Specifically, we consider how those measures may minimize exposure of Atlantic sturgeon to pile driving noise. Details of these proposed measures are included in the Description of the Action section above.

Atlantic sturgeon are not visible to PSOs because they occur near the bottom and depths in the areas where pile driving is planned would preclude visual observation of fish near the bottom. Therefore, monitoring of clearance zones or areas beyond the clearance zones will not minimize exposure of Atlantic sturgeon to pile driving noise. Because Atlantic sturgeon do not vocalize, PAM cannot be used to monitor Atlantic sturgeon presence; therefore, the use of PAM will not reduce exposure of Atlantic sturgeon to pile driving noise.

No impact pile driving activities for monopiles would occur between January 1 and April 30 to avoid the time of year with the highest densities of right whales in the project area. Information from Ingram et al. (2019) indicates that abundance of Atlantic sturgeon in the New York Wind Energy Area peaked from November through January. If seasonal patterns are similar in the Atlantic Shores WDA, the seasonal restriction would reduce the number of Atlantic sturgeon that would otherwise have been exposed to foundation pile driving noise; however, we are not able to produce any quantitative estimates of the extent of the reduction.

For all impact pile driving, Atlantic Shores would implement sound attenuation technology that would target at least a 10 dB reduction in noise, and that must achieve in-field measurements no greater than those modeled and presented in the BA and summarized in Table 7.1.29 above. The attainment of a 10 dB reduction in impact pile driving was incorporated into the estimates of the area where injury or behavioral disruption may occur as presented above. If a reduction greater than 10 dB is achieved, the size of the area of impact would be smaller which would likely result in a smaller number of Atlantic sturgeon exposed to pile driving noise.

Soft start procedures can provide a warning to animals or provide them with a chance to leave the area prior to the hammer operating at full capacity. As described above, for impact pile driving before full energy pile driving begins, pile driving will occur at 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy (i.e., 440 to 880 kJ for monopiles and 250 to 500 kJ for jackets), for a minimum of 20 minutes. During installation of any piles, at this hammer intensity, a sturgeon would need to be within 100 m of the pile being driven, to be exposed to be exposed to noise above the 206 dB re 1uPa threshold (see Tables F-93 to F-104 in Weirathmueller et al. 2023). Given the dispersed nature of Atlantic sturgeon in the lease area and the presence of the bubble curtains at approximately this distance from the pile, this co-occurrence is extremely unlikely to occur. We expect that any Atlantic sturgeon close enough to the pile to be exposed to noise above 150 dB re 1uPa rms would experience behavioral disturbance as a result of exposure to the pile driving noise during the soft start and that these sturgeon would exhibit evasive behaviors and swim away from the noise source. During the soft start period, noise will be above 150 dB at a distance of at least 3.3 km from a monopile being driven and at least 2 km from a pin pile (see Tables F-93 to F-104 in Weirathmueller et al. 2023). The use of the soft start is expected to give Atlantic sturgeon near enough to the piles to be exposed to the soft start noise a "head start" on escape or avoidance behavior by causing them to swim away from the source. It is possible that some Atlantic sturgeon would swim out of the noisy area before full force pile driving begins; in this case, the number of Atlantic sturgeon exposed to noise that may result in injury would be reduced. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in behavioral disturbance. However, we are not able to predict the extent to which the soft start will reduce the extent of exposure above the 150 dB re 1uPa threshold for considering behavioral impacts.

As described above, Atlantic Shores will also conduct hydroacoustic monitoring (SFV) for a subset of impact-driven piles. The required sound source verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. If noise levels are higher than predicted by the modeling described here, additional noise attenuation measures will be implemented to reduce distances to the injury and behavioral disturbance thresholds. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than those modeled, this may be considered new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation may be necessary.

Exposure to Noise above the Onset of Injury Threshold during Impact Pile Driving for Foundations

Acoustic range modeling (Table 7.1.29) indicates that in order to be exposed to pile driving noise that could result in injury, an Atlantic sturgeon would need to be within 150 m of a monopile and within 50 m of a pin pile for a single pile strike (based on the 206 dB peak threshold). Given the dispersed distribution and transient nature of Atlantic sturgeon in and near the WDA, the potential for co-occurrence in time and space is extremely unlikely given the small area where exposure to peak noise could occur (extending less than 150 m from the pile). We also expect that the bubble curtain(s) deployed as part of the noise attenuation system will extend further than 150 m from the pile, this is likely to further deter Atlantic sturgeon from being closer than that to the pile. The soft-start, which we expect would result in a behavioral reaction and movement outside the area with the potential for exposure to the peak injury threshold, reduces this risk even further. As described above, during the soft start, an Atlantic sturgeon would need to be closer than 100 meters of the pile being driven to be exposed to peak noise that could result in physiological effects. Given these considerations, we do not anticipate any Atlantic sturgeon to be exposed to noise above the peak injury threshold during monopile installation.

Considering the 187 dB SELcum threshold (see Table 7.1.29), an Atlantic sturgeon would need to remain within approximately 5.5-6 km of a single monopile (with distance dependent on location and pile size) for the duration of the pile driving event (i.e., 7 to 9 hours) or stay within approximately 5.7-6.5 km of all pin piles installed in a 24 hour period (3 hours per pile, 12 hours total pile driving). Considering the anticipated behavioral reaction of sturgeon to avoid pile driving noise above 150 dB re 1 uPa RMS and the swimming abilities of Atlantic sturgeon, this is extremely unlikely to occur. Downie and Kieffer (2017) reviewed available information on maximum sustained swimming ability (Ucrit) for a number of sturgeon species. No information was presented on Atlantic sturgeon. Kieffer and May (2020) report that swimming speed of sturgeons is consistent at approximately 2 body lengths/second. Considering that the smallest Atlantic sturgeon in the ocean environment where piles will be driven will be migratory subadults (at least 75 cm length), we can assume a minimum swim speed of 150 cm/second (equivalent to 5.4 km/hour) for Atlantic sturgeon in the WDA. Assuming a straight line escape and the slowest anticipated swim speed (5.4 km/h), even a sturgeon that was close by the pile at the start of pile driving would be able to swim away from the noisy area well before being exposed to the noise for a long enough period to meet the 187 dB SELcum threshold. The distance we would expect a sturgeon to cover in the approximately 7 to 9 hours it would take to install a WTG monopile is at least 37.86 km, in the 3 hours it would take to install a single pin pile, a sturgeon could swim 16.2 km; these distances are at least double the distance a sturgeon would need to swim to escape from noise above the cumulative injury (187 dB cSEL) threshold. We expect that the soft-start will mean that the closest a sturgeon is to the pile being driven at the start of full power driving is several hundred meters away which further reduces the duration of exposure to noise that could accumulate to exceed the 187 dB SELcum threshold. Given these considerations, we expect any Atlantic sturgeon that are exposed to pile driving noise will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Based on this analysis and consideration of the peak and cumulative noise thresholds for injury, it is extremely unlikely that any Atlantic sturgeon will be exposed to noise that will result in injury. Therefore, no take by harm (i.e. injury) of any Atlantic sturgeon is expected to occur.

Effects of Noise Exposure above 150 dB re 1uPa rms but below the injury threshold
We expect Atlantic sturgeon to exhibit a behavioral response upon exposure to noise that is louder than 150 dB re 1uPa RMS. This response could range from a startle with immediate resumption of normal behaviors to complete avoidance of the area. The area where pile driving will occur is used for migration of Atlantic sturgeon, with opportunistic foraging expected to

occur where suitable benthic resources are present. The area is not an aggregation area and sustained foraging is not known to occur in this area.

During the 7 to 9 hour periods where impact pile driving occurs for monopile foundations, the area that will have underwater noise above the 150 dB re 1uPa RMS threshold will extend approximately 7.12 to 7.23 km from the pile being installed; for the three hour period that each pin pile is being driven that area will extend up to approximately 5 km from the pile being installed. We expect that Atlantic sturgeon exposed to noise above 150 dB re 1uPa RMS would exhibit a behavioral response and may temporarily avoid the entire area where noise is louder than 150 dB re 1uPa RMS. The consequences for an individual sturgeon would be alteration of movements to avoid the noise and temporary cessation of opportunistic foraging. Considering the minimum swimming speeds noted above, we expect a sturgeon actively avoiding this area could swim out of it in 1 to 2 hours.

While in some instances temporary displacement from an area may have significant consequences to individuals or populations, this is not the case here. For example, if individual Atlantic sturgeon were prevented or delayed from accessing spawning habitat or were precluded from a foraging area for an extensive period, there could be impacts to reproduction and the health of individuals, respectively. However, as explained above, the area where noise may be at disturbing levels is used only for movement between other more highly used portions of the coastal Atlantic Ocean and is used only for opportunistic, occasional foraging; avoidance of any area ensonified during impact pile driving for the foundations would not block or delay movement to spawning, foraging, or other important habitats.

All behavioral responses to a disturbance, such as those described above, will have an energetic or metabolic consequence to the individual reacting to the disturbance (e.g., adjustments in migratory movements or disruption in opportunistic foraging). Short-term interruptions of normal behavior are likely to have little effect on the overall health, reproduction, and energy balance of an individual or population (Richardson *et al.* 1995). As the disturbance will occur for a portion of each day for a period of up to approximately 124 days in year 1 of foundation pile driving and up to 107 days in year 2, this exposure and displacement will be temporary and not chronic. Therefore, any interruptions in behavior and associated metabolic or energetic consequences will similarly be temporary. Thus, we do not anticipate any impairment of the health, survivability, or reproduction of any individual Atlantic sturgeon.

As explained above, NMFS Interim Guidance defines harassment as to "[c]reate the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." Here, we consider whether the effects to Atlantic sturgeon resulting from exposure to pile driving noise meet the ESA definition of harassment. We have established that some Atlantic sturgeon are likely to be exposed to the stressor or disturbance (in this case, pile driving noise above 150 dB re 1uPa rms). This disturbance is expected to be intermittent and limited in time and space as it will only occur when active pile driving is occurring and only in the geographic area where noise is above the behavioral disturbance threshold. As explained above, the expected response of any Atlantic sturgeon exposed to disturbing levels of noise, are expected to be alterations to their movements and swimming away from the source of the noise. This means they will need to alter their migration route; foraging would also be disrupted during this period. This will result in minor, temporary energetic costs that are expected to be fully recoverable. The nature, duration, and intensity of the response will not be a significant disruption of any behavior patterns. This is because any alterations of the movements of an individual sturgeon to avoid pile driving noise will be a minor disruption of migration, potentially taking it off of its normal migratory path for a few hours but not disrupting its overall migration (e.g., it will not result in delays or other impacts that would have a consequence to the individual). Similarly, any disruption of foraging will be temporary and limited to the few hours that the sturgeon is moving away from the noise. As the area where these impacts will occur is an area where only occasional, opportunistic foraging will occur, this will not be a significant disruption to foraging behavior. Based on this analysis, the nature and duration of the response to exposure to pile driving noise above the behavioral disturbance threshold is not a significant disruption of behavior patterns; therefore, no take by harassment is anticipated. Based on this analysis we have similarly determined that it is extremely unlikely that any Atlantic sturgeon will be exposed to noise which actually kills or injures any individual; thus no take by harm is anticipated.

We have also considered if the avoidance of the area where pile driving noise will be experienced would increase the risk of vessel strike or entanglement in fishing gear. As explained above, a sturgeon would need to travel no more than 5 to 7.25 km to swim outside the area where noise is above the threshold where behavioral disturbance is expected; this distance would result from a sturgeon being very near the source when pile driving started, it is more likely that the distance traveled would be smaller. As we do not expect vessel strike to occur in the open ocean, regardless of traffic levels, we do not expect any increase in risk of vessel strike even if a sturgeon was displaced into an area with higher vessel traffic. Based on the available information on the distribution of fishing activities that may interact with sturgeon (i.e., gillnets, trawl), it is extremely unlikely that a sturgeon avoiding pile driving noise would be more at risk of entanglement or capture than had it not been exposed to the noise source. This is because the distance that a sturgeon would need to move to avoid potentially disturbing level of noise would not put the individual in areas with higher levels of trawl or gillnet fishing than in the WDA. Based on this analysis, all effects to Atlantic sturgeon from exposure to impact pile driving noise are expected to be extremely unlikely and thus discountable, or so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, insignificant. Take is not anticipated as a result of exposure to noise from driving of WTG, OSS or Met Tower foundations.

Vibratory Pile Driving for Sheet Pile Installation and Removal

The injury thresholds for fish outlined above (FHWG 2008) are only for impulsive sound sources. Non-impulsive sources, such as vibratory pile driving, do not have the high peak sound pressure with rapid rise time typical of impulsive sounds. At this time, there is no information to indicate that vibratory pile driving has the potential to result in the injury of fish. As such, NMFS only considers the 150 dB re: 1uPa rms “behavioral response” threshold when considering effects of exposure to vibratory pile driving noise.

As noted in the BA, maximum root mean squared sound pressure levels (L_{rms}) measured by Illingworth and Rodkin (2017), which were used to model sound propagation of vibratory pile driving for marine mammals to support Atlantic Shores' LOA application, reached 170 dB re 1 µPa at 32.8 feet (10 meters) from the source. The BA does not present estimated distances to the 150 dB threshold, above which we expect sturgeon may exhibit a behavioral response. As such, we used the NMFS multi-species pile driving calculator[45] to estimate distance to the threshold.

Noise resulting from pile driving for the sheet piles is expected to exceed the behavioral disturbance threshold at a distance of approximately 215 m. Avoidance or displacement of an area with a radius of 215 m will have effects on Atlantic sturgeon that are so small that they cannot be meaningfully measured, evaluated, or detected; this is because of the small size of the area, the temporary nature of any displacement, and because sturgeon in this area are only migrating or potentially opportunistically foraging. Effects are therefore insignificant. No take of any Atlantic sturgeon is expected to result from exposure to noise resulting from pile driving for the sheet piles.

As part of the Connected Action, an existing sheet pile bulkhead located within an existing marina basin at Atlantic City will be repaired/rehabilitated through the installation of approximately 356 linear feet of steel or vinyl sheet piles with a vibratory hammer. The schedule (13 to 14 48" piles per day) is expected to be similar to installation of piles for the cofferdams. As with those piles, noise is not expected to exceed the behavioral disturbance threshold at a distance of approximately 215 m. Given the location of the bulkhead in an existing marina basin where few, if any, Atlantic sturgeon are expected to occur, the extremely small area where noise will be above the behavioral threshold, and the short duration of pile installation (estimated at no more than 12 hours a day for approximately 7 days), it is extremely unlikely that any Atlantic sturgeon would be exposed to noise that is expected to result in a behavioral response and effects are discountable. No take of any Atlantic sturgeon is expected to result from exposure to noise resulting from pile driving for the sheet piles to support bulkhead rehabilitation.

Vessel Noise and Cable Installation

The vessels used for the proposed project will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type. Noise produced during cable installation is dominated by the vessel noise; therefore, we consider these together. Vessels operating with dynamic positioning thrusters produce peak noise of 171 dB SEL peak at a distance of 1 m, with noise attenuating to below 150 dB rms at a distance of 135 m (BOEM 2021, see table 23).

In general, information regarding the effects of vessel noise on fish hearing and behaviors is limited. Some TTS has been observed in fishes exposed to elevated background noise and other white noise, a continuous sound source similar to noise produced from vessels. Caged studies on sound pressure sensitive fishes show some TTS after several days or weeks of exposure to increased background sounds, although the hearing loss appeared to recover (e.g., Scholik and

[45] https://www.fisheries.noaa.gov/resource/data/multi-species-pile-driving-calculator-tool

Yan 2002; Smith et al. 2006; Smith et al. 2004b). Smith et al. (2004b) and Smith et al. (2006) exposed goldfish (a fish with hearing specializations, unlike any of the ESA-listed species considered in this opinion) to noise with a sound pressure level of 170 dB re 1 μPa and found a clear relationship between the amount of TTS and duration of exposure, until maximum hearing loss occurred at about 24 hours of exposure. A short duration (e.g., 10-minute) exposure resulted in 5 dB of TTS, whereas a three-week exposure resulted in a 28 dB TTS that took over two weeks to return to pre-exposure baseline levels (Smith et al. 2004b). Recovery times were not measured by researchers for shorter exposure durations, so recovery time for lower levels of TTS was not documented.

Vessel noise may also affect fish behavior by causing them to startle, swim away from an occupied area, change swimming direction and speed, or alter schooling behavior (Engas et al. 1998; Engas et al. 1995; Mitson and Knudsen 2003). Physiological responses have also been documented for fish exposed to increased boat noise. Nichols et al. (2015b) demonstrated physiological effects of increased noise (playback of boat noise) on coastal giant kelpfish. The fish exhibited acute stress responses when exposed to intermittent noise, but not to continuous noise. These results indicate variability in the acoustic environment may be more important than the period of noise exposure for inducing stress in fishes. However, other studies have also shown exposure to continuous or chronic vessel noise may elicit stress responses indicated by increased cortisol levels (Scholik and Yan 2001; Wysocki et al. 2006). These experiments demonstrate physiological and behavioral responses to various boat noises that have the potential to affect species' fitness and survival, but may also be influenced by the context and duration of exposure. It is important to note that most of these exposures were continuous, not intermittent, and the fish were unable to avoid the sound source for the duration of the experiment because this was a controlled study. In contrast, wild fish are not hindered from movement away from an irritating sound source, if detected, so are less likely to be subjected to accumulation periods that lead to the onset of hearing damage as indicated in these studies. In other cases, fish may eventually become habituated to the changes in their soundscape and adjust to the ambient and background noises.

All fish species can detect vessel noise due to its low-frequency content and their hearing capabilities. Because of the characteristics of vessel noise, sound produced from vessels is unlikely to result in direct injury, hearing impairment, or other trauma to Atlantic sturgeon. In addition, in the near field, fish are able to detect water motion as well as visually locate an oncoming vessel. In these cases, most fishes located in close proximity that detect the vessel either visually, via sound and motion in the water would be capable of avoiding the vessel or move away from the area affected by vessel sound. Thus, fish are more likely to react to vessel noise at close range than to vessel noise emanating from a greater distance away. These reactions may include physiological stress responses, or avoidance behaviors. Auditory masking due to vessel noise can potentially mask biologically important sounds that fish may rely on. However, impacts from vessel noise would be intermittent, temporary, and localized, and such responses would not be expected to compromise the general health or condition of individual fish from continuous exposures. Instead, the only impacts expected from exposure to project vessel noise for Atlantic sturgeon may include temporary auditory masking, physiological stress, or minor changes in behavior.

Therefore, similar to marine mammals and sea turtles, exposure to vessel noise for fishes could result in short-term behavioral or physiological responses (e.g., avoidance, stress). Vessel noise would only result in brief periods of exposure for fishes and would not be expected to accumulate to the levels that would lead to any injury, hearing impairment or long-term masking of biologically relevant cues. The effects of exposure to vessel noise will be so minor that they cannot be meaningfully measured, detected, or evaluated. Therefore, the effects of vessel noise on Atlantic sturgeon are considered insignificant and take will not occur.

Operation of WTGs
As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Atlantic Shores project. Elliot et al. (2019) reports underwater noise monitoring at the Block Island Wind Farm, which has direct-drive GE Haliade turbines and HDR 2023 reports underwater noise monitoring for the 12 MW CVOW turbines; as explained in section 7.1.2, this is the best available data for estimating operational noise of the Atlantic Shores turbines. As reported in Eliot et al, 2016, the loudest noise recorded was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh. In HDR 2023, noise reached 145 dB within 350 m of the monopile only during stormy conditions. As noted above, based on wind speed records within the WDA (Atlantic Shores COP) and the nearby Ambrose Buoy, the annual maximum wind speed (10-minute average) is 50.3 mph in the WDA and instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, with wind speeds exceeding 40 km/h less than 3% of the time across a year. HDR reports that recorded particle acceleration levels were compared to published behavioral audiograms of selected fish species (e.g., Atlantic salmon *[Salmo salar]*, dab [*Limanda limanda*], Atlantic cod [*Gadus morhua*], and plaice) and were found to be below the respective hearing thresholds for these species.

As underwater noise associated with the operation of the WTGs is expected to be below the thresholds for injury or behavioral disturbance for Atlantic sturgeon, we do not expect any impacts to any Atlantic sturgeon due to noise associated with the operating turbines. Additionally, we note that many studies of fish resources within operating wind farms, including the Block Island Wind Farm, and wind farms in Europe with the older, louder geared turbines report localized increases in fish abundance during operations (due to the reef effect; e.g., Stenburg et al. 2015, Methartta and Dardick 2019, Wilber et al. 2022). This data supports the conclusion that operational noise is extremely unlikely to result in the displacement or disturbance of Atlantic sturgeon and these effects are thus discountable.

HRG Surveys
Some of the equipment that is described by BOEM for use for surveys produces underwater noise that can be perceived by Atlantic sturgeon. Of the equipment that is proposed by Atlantic Shores, this is limited to sparkers and CHIRPs. This may include boomers, sparkers, and bubble guns. Extensive information on HRG survey noise and potential effects of exposure to Atlantic sturgeon is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021). We summarize the relevant conclusions here. The maximum distance to the injury threshold is 9 m and the maximum

distance to the 150 dB re 1uPa behavioral disturbance threshold is 1.9 km for the loudest equipment (sparker).

Table 7.1.30 Largest PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots – Fish

HRG Source	**Highest Source Level (dB re 1 μPa)**	**Distance to Fish Thresholds in m (FHWG 2008)**		
		Peak	*SEL*	*Behavior (150 dB re 1uPa rms)*
Boomers		3.2	0	708
Sparkers	188 dB SEL	9	0	1,996[a]
	214 dB RMS			
	225 PEAK			
CHIRP	193 dB SEL		0	32
	209 dB RMS	0		
	214 PEAK			

a – the calculated distance to the 150 dB rms threshold for the Applied Acoustics Dura-Spark is 1,996m; however, the distances for other equipment in this category is significantly smaller
NA = not applicable due to the sound source being out of the hearing range for the group.

As explained above, the available information suggests that for noise exposure to result in physiological impacts to the fish species considered here, received levels need to be at least 206 dB re: 1uPa peak sound pressure level (SPLpeak) or at least 187 dB re: u1Pa cumulative. The peak thresholds are exceeded only very close to the noise source (<9 m for the sparkers, 3.2 m for boomers); the cumulative threshold is not exceeded at any distance. As such, in order to be exposed to peak sound pressure levels of 206 dB re: 1uPa from any of these sources, an individual fish would need to be within 9 m of the source. This is extremely unlikely to occur given the dispersed nature of the distribution of ESA-listed Atlantic sturgeon in the action area, the use of a ramp up procedure, the moving and intermittent/pulsed characteristic of the noise source, and the expectation that ESA-listed fish will swim away, rather than towards the noise source. Based on this, no physical effects to any Atlantic sturgeon, including injury or mortality, are expected to result from exposure to noise from the geophysical surveys; we consider the potential for effects on behavior below.

The calculated distances to the 150 dB re: 1 uPa rms threshold for the sparkers is up to 1,996 m while the distance for the CHIRPs is 32 m. It is important to note that these distances are calculated using the highest power levels for each sound source reported in Crocker and

Fratantonio (2016); thus, while they may overestimate actual sound fields, they are still within a reasonable range to consider.

Because the area where increased underwater noise will be experienced is transient (because the survey vessel towing the equipment is moving), increased underwater noise will only be experienced in a particular area for a short period of time. Given the transient and temporary nature of the increased noise, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, potential temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging, resting, or migrations are disrupted, we expect that these behaviors will quickly resume once the survey vessel has left the area (i.e., in seconds to minutes, given its traveling speed of 3 – 4.5 knots). Therefore, no fish will be displaced from a particular area for more than a few minutes. While the movements of individual fish will be affected by the sound associated with the survey, these effects will be temporary and localized. These fish are not expected to be excluded from any particular area, and there will be only a minimal impact on foraging, migrating, or resting behaviors. Sustained shifts in habitat use, distribution, or foraging success are not expected. As established above, no injury or mortality is anticipated to result from exposure to noise from HRG surveys. Effects to individual fish from brief exposure to potentially disturbing levels of noise are expected to be limited to a brief startle or short displacement and will be so small that they cannot be meaningfully measured, detected, or evaluated; therefore, effects of exposure to survey noise are insignificant. Take is not anticipated to occur.

7.1.6 Effects of Noise on Prey

The ESA listed species in the WDA forage in varying frequencies and intensities on a wide variety of prey. With the exception of fish, little information is available on the effects of underwater noise on many prey species, such as most benthic invertebrates and zooplankton, including copepods and krill. Effects to schooling fish that are preyed upon by some whale species are likely to be similar to the effects described for Atlantic sturgeon; that is, effects are expected to be limited to temporary behavioral disturbance with no injury or mortality anticipated. However, like Atlantic sturgeon, we expect these disturbances and changes in distribution to be temporary and not represent any reduction in biomass or reduction in the availability of prey. Most benthic invertebrates have limited mobility or move relatively slowly compared to the other species considered in this analysis. As such, there may be some small reductions in prey for sea turtles and Atlantic sturgeon as a result of exposure of benthic prey species to pile driving noise. However, these reductions are expected to be small and limited to the areas immediately surrounding the piles being installed. We expect that the effects to Atlantic sturgeon and loggerhead and Kemp’s ridley sea turtles from any small and temporary reduction in benthic invertebrates due to exposure to pile driving noise to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. No take is anticipated as a consequence of disturbance to prey.

We are not aware of any information on the effects of pile driving noise exposure to krill, copepods, or other zooplankton. McCauley et al. (2017) documented mortality of juvenile krill exposed to seismic airguns. No airguns are proposed as part of the Atlantic Shores project. We are not aware of any evidence that pile driving noise, HRG surveys, or the other noise sources considered here are likely to result in the mortality of zooplankton. Effects to marine mammals due to disturbance of prey are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. No take is anticipated to occur.

Similarly, we expect that any effects of operational noise on the prey of ESA listed species to be extremely unlikely or so small that they cannot be meaningfully measured, detected, or evaluated. As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Atlantic Shores project. As explained above, we have determined that Elliot et al. (2019) and HDR 2023 is the best available data for estimating operational noise of the Atlantic Shores turbines. The loudest noise recorded at BIWF was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh (Eliot et al. 2019); at CVOW, the loudest noise recorded was 145 dB at a distance of 350 m. As noted above, based on wind speed records within the WDA (Atlantic Shores COP) and the nearby Ambrose Buoy, the annual maximum wind speed (10-minute average) is 50.3 mph in the WDA and instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, with wind speeds exceeding 40 km/h less than 3% of the time across a year[46].

Elliot et al. note that based on monitoring of underwater noise at the Block Island site, the noise levels identified in the vicinity of the turbine are far below any numerical criteria for adverse effects on fish. HDR 2023 is consistent with those findings. As underwater noise associated with the operation of the WTGs is expected to be below the thresholds for injury or behavioral disturbance for fish species, we do not expect any impacts to any fish species due to noise associated with the operating turbines. There is no information to indicate that operational noise will affect krill, copepods, or other zooplankton. Additionally, we note that many studies of fish and benthic resources within operating wind farms, including the Block Island Wind Farm, and wind farms in Europe with the older, louder geared turbines report localized increases in fish and benthic invertebrate abundance during operations (due to the reef effect; e.g., Stenburg et al. 2015, Methartta and Dardick 2019, Wilber et al. 2022). This data supports the conclusion that operational noise is not likely to result in the displacement or disturbance of prey species. As effects to prey from operational noise on prey are extremely unlikely, effects to ESA listed species resulting from impacts to prey are also extremely unlikely and therefore, discountable.

7.2 Effects of Project Vessels

In this section we consider the effects of the operation of project vessels on listed species in the action area by describing the existing vessel traffic in the action area (as previously summarized in the environmental baseline, Section 6.0 of this Opinion), estimating the anticipated increase in vessel traffic associated with construction, operations, and decommissioning of the project, and then analyzing risk and determining likely effects to sea turtles, listed whales, and sturgeon. We also consider impacts to air quality from vessel emissions and whether those impacts may cause effects to listed species. Section 3.0 of the Opinion describes proposed vessel use over all phases of the project, and is not repeated here but some information is summarized. Effects of vessel

[46] https://www.windfinder.com/windstatistics/ambrose_buoy. and https://www.ndbc.noaa.gov/station_page.php?station=44065; last accessed December 1, 2023

noise were considered in Section 7.1, above, and are not repeated here. Project vessels will operate in two areas over the life of the project: 1) in and around the lease area and cable corridor and to/from relatively nearby ports in Atlantic City, NJ, and the Delaware River/Bay (Paulsboro Marine Terminal, New Jersey Wind Port, Repauno); and 2) between the lease area and more distant ports in Portsmouth, VA, and Corpus Christi, TX. Transits during the operation period will only be between the lease area and cable corridor and the O&M facility in Atlantic City, with the exception of a limited number of vessel transits of fisheries and benthic survey vessels from ports along the Atlantic coast of New Jersey and other identified ports as described below.

7.2.1 Project Vessel Descriptions and Increase in Vessel Traffic from Proposed Project

Descriptions of project vessel use and traffic are described in Section 3.0 of this Opinion and summarized here for reference. Vessel traffic will occur in the lease area, along the offshore export cable routes, and along routes between the lease area and export cable routes and the ports used to support Project construction. Construction vessels will travel between the WDA and the following ports that are expected to be used during construction (as described in BOEM's BA): New Jersey Wind Port (Salem, NJ), Paulsboro Marine Terminal (Paulsboro, NJ) and Repauno Port and Rail Terminal (Repauno, New Jersey); Portsmouth, Virginia; and Corpus Christi, Texas; as well as a new O&M facility in Atlantic City, New Jersey. During construction, 72% of the vessel trips would travel between the WDA and NJWP (Table 7.2.1; 1,250 trips). Of the remaining vessel trips, most would travel between the WDA and Atlantic City (315 trips), 120 trips would travel between the WDA and Paulsboro, New Jersey, while 20 trips each are estimated to travel between the WDA and Portsmouth, Virginia, Corpus Christi, Texas, and Repauno, New Jersey. Vessels carrying out fisheries and benthic surveys are expected to operate from local ports. The amount of time vessels will transit back and forth to the WDA and how long they will remain on station is greatly dependent on final design factors, weather, sea conditions, and other natural factors.

Table 7.2.1. Potential Primary Ports and Estimated Total Number of Vessels and Trips Needed to Support Construction Activities. Trips are Between the Identified Port and the ASOW WDA.

Vessel Type / Number	Maximum Total Trips	Anticipated Ports
CTV / 8	1,999	Atlantic City
		NJWP
SOV / 3	36	NJWP
JUV / 2	13	NJWP
Dredger / 4	8	NJWP
Heavy Lift Vessel / 2	2	NJWP
Fall Pipe Vessel / 1	28	TBC
Bubble Curtain Support Vessel / 1	11	NJWP
Service Operations Vessel / 1	2	NJWP
Towing Tug / 10	108	NJWP
Jack-Up Feeder / 2	100	NJWP
Anchor Handling Vessel / 2	2	NJWP
Barge / 8	100	NJWP
Tug / 2	26	NJWP
Cable Installation Vessel / 2	8	NJWP
Cable Burial Vessel / 1	2	NJWP
Fall Pipe Vessel / 3	6	TBC
Miscellaneous / 5	5	Miscellaneous

Source: Table 1-8 in the ASOW BA
Note: All CTV captures all support and transport vessel numbers and trips.
CTV = crew transfer vessel; WTG = wind turbine generator; SOV = Support Vessel; JUV = Jack-Up Vessel;

Table 7.2.2. Potential U.S. Atlantic Ports and Usage during Atlantic Shores Offshore Wind South Construction.

State	Port	Summary of Potential Activities		
		Construction	O & M Activities	Decommissioning
Texas	Corpus Christi	X		X
New Jersey	New Jersey Wind Port	X	X	X
	Paulsboro Marine Terminal	X	X	X
	Repauno	X	X	X
	Atlantic City	X	X	X
Virginia	Portsmouth	X	X	X

Source: Table 1-9 in the ASOW BA.

Construction of the offshore export cables will require various vessel types including a cable-laying vessel, tugs, barges, and work and transport vessels (see table 3.5). Cable installation will begin at the offshore site of the sea-to-shore transition points and proceed to the Atlantic Shores South OSSs. Project components may be transported by vessels from the following U.S. ports: NJWP, Atlantic City, Repauno, and Paulsboro, NJ; Portsmouth, VA, and Corpus Christi, TX.

Vessel traffic during the construction phase will primarily consist of construction vessels, which are generally slower moving (<10 knots) installation and transport vessels that range from 230 to 656 ft. in length, from 49 to 197 ft. in beam, and draft from 4 to 10 ft., as well as smaller (from 80 to 100 ft. in length) and faster moving support vessels (maximum speeds up to 29 knots). The larger installation vessels, like the floating/jack-up crane and cable-laying vessel, will generally travel to and out of the construction area at the beginning and end of the wind farm construction and will not make transits on a regular basis. Tugs and barges transporting construction equipment and materials will make more frequent trips (e.g., weekly) from ports to the project site while smaller support vessels carrying supplies and crew may travel to the WDA daily. However, we note that construction crews responsible for assembling the WTGs will hotel onboard installation vessels at sea thus limiting the number of crew vessel transits expected during wind farm installation. As described in the BA (see Table 1-8), the anticipated normal operating speeds of all vessels, except crew transport vessels (<29 knots) and some project support vessels, is 10 knots or less. Within the lease area, many vessels will be stationary or very slow moving (4 knots or less).

During O&M, vessel traffic will be limited to routine maintenance visits and non-routine maintenance, as needed; nearly all O&M transits will occur from the O&M facility at Atlantic City NJ with a small number from NJWP, Paulsboro, Repauno, and/or Portsmouth. As described in the BA, project decommissioning is expected to require a total of 1,745 trips between various ports (primarily NJWP) and the WDA. Vessel types used during the decommissioning phase of the project are anticipated to be similar to those used during the installation phase.

Additionally, there will be limited vessel traffic that will be associated with the marine resource survey and monitoring activities (fisheries surveys, benthic monitoring) that will occur pre, during, and post-construction, for a period up to seven years total. The associated vessel trips to execute monitoring for the Project (passive acoustic monitoring, HRG surveys, benthic, and fisheries) would include a small number of survey vessels consisting of three HRG vessels, 1 vessel to carry out grab samples, and one vessel each to carry out trawl, clam dredge, and ventless trap surveys as well as a small number of additional vessels to complete other identified survey and monitoring activities for a total of approximately 10 survey vessels annually. During survey activities, vessels are expected to be moving slowly at speeds of 5 knots or less.

In summary, as described by BOEM in the BA, total vessel trips during the construction period are 1,745 transits over a 3-year construction period (anticipated over 4 calendar years); these trips will be between the WDA and the ports identified above. During the operation period, 1,861 vessel trips will occur annually, with the exception of the survey trips noted above, most trips would occur to/from Atlantic City with a small number (37 or less per year) occurring from either NJWP, Repauno, Paulsboro, or Portsmouth. During the decommissioning period, 1,745 round trips are anticipated. As explained in section 6.0, the best available data indicate there are at least 74,352 vessel transits annually in the area that the Atlantic Shores South vessel transits will overlap. The table below describes the calculated increase in traffic attributable to Atlantic Shores South 1 project vessels above that baseline.

Table 7.2.3. Percent Increase Above Baseline Vessel Traffic in the Project Area Due to Atlantic Shores South Project Vessels

Phase	Annual Project-Related Vessel Transits [a]	Phase Duration	% Increase in Annual Vessel Transits in the Project Area[b]
Construction	1,745	3 years	+ 2.3%
Operation	1,861	35 years	+ 2.5%
Decommissioning	1,745	2 years	+ 2.3 %

[a] Source: BOEM July 2023 BA
[b] Source: Baseline vessel traffic in the Project Area is 74,352 transits (USCG 2020)

7.2.2 Minimization and Monitoring Measures for Vessel Operations

There are a number of measures that Atlantic Shores is proposing to take and/or BOEM is proposing to require as conditions of COP approval that are designed to avoid, minimize, or monitor effects of the action on ESA listed species during construction, operation, and decommissioning of the project. NMFS OPR's proposed MMPA ITA also contains requirements for vessel strike avoidance measures for marine mammals; these measures will be implemented over the 5 year effective period of the ITA. The complete list of measures that are part of the proposed action is provided in Appendices A and B of this Opinion. These measures can be grouped into two main categories: vessel speed reductions and increased vigilance/animal avoidance. These measures are all considered part of the proposed action or are otherwise required by regulation (62 FR 6729, February 13, 1997), (66 FR 58066, November 20, 2001), (73 FR 60173, October 10, 2008).

Specific measures related to vessel speed reduction that are part of the proposed action (inclusive of the requirements included in the proposed MMPA ITA, see Section 3.0 and Appendixes A and B) include:

During the 5-year effective period of the MMPA ITA (January 2025 - December 2029; covers the construction period and 1-2 years of operations):

- In the event that any Slow Zone (DMA or acoustically triggered slow zone) is established that overlaps with an area where a project-associated vessel would operate, that vessel, regardless of size, will transit that area at 10 knots or less.
- All vessels, regardless of size, will operate at 10 knots or less in any SMA.
- Between November 1 and April 30, all vessels, regardless of size, would operate port to port (specifically from ports in New Jersey and Virginia) and while in the cable corridor and lease area at 10 knots or less
- All vessels, regardless of size, would immediately reduce speed to 10 knots or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed near (within 100 m) an underway vessel.
- All vessels, regardless of size, would immediately reduce speed to 10 knots or less when a North Atlantic right whale is sighted, at any distance, by an observer or anyone else on the vessel.

- From May 1 to October 31, for all vessels, in order for a vessel to travel at greater than 10 knots, a vessel must be outside of an SMA or Slow Zone/DMA, and be within a "transit corridor" being monitored by real time PAM. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all vessels must travel at 10 knots or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 12 hours.

Following the 5-year effective period of the ITA, BOEM's proposed conditions of COP approval (as described in Appendix A), include requiring Atlantic Shores to comply with their proposed vessel strike avoidance plan which includes:

- Installing and operating year-round a semi-permanent acoustic network comprising near real-time bottom mounted and/or mobile acoustic monitoring platforms such that confirmed NARW detections are regularly transmitted to a central information portal and disseminated through the situational awareness network. This will cover identified transit corridors and the lease area;
    - The transit corridor (i.e., the path a Project vessel will use to transit between the Project Area and the port from which the vessel is operating) and Offshore Project Areas will be divided into detection action zones;
        - Localized detections of right areas 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 slow-down zone 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 the efficacy of PAM equipment deployed and subject to NMFS approval as part of the NARW Vessel Strike Avoidance Plan.
- Vessels, other than CTVs, greater than 65' in length must operate at 10 knots or less between November 1 and April 30.
- Year round, CTVs may operate at speeds greater than 10 knots only when operating in an area covered by the PAM detection network and when right whale detections have not triggered a slow-down to 10 knots or less (i.e., only when no right whales have been detected in the previous 12 hour period).
- Between May 1 and October 31, vessels may operate at speeds greater than 10 knots only when operating in an area covered by the PAM detection network and when right whale detections have not triggered a slow-down to 10 knots or less (i.e., only when no right whales have been detected in the previous 12 hour period).
- Regardless of vessel size or type, vessel operators must reduce vessel speed to 10 knots (11.5 miles per hour) or less while operating in any SMA or DMA/visually detected Slow Zones.

- All underway vessels (transiting or surveying) operating at greater than 10 knots would have a dedicated visual observer (or NMFS-approved automated visual detection system in the event such a system is approved) on duty at all times to monitor for marine mammals within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). Visual observers will be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, and fog). 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. Detection of a marine mammal will trigger appropriate vessel speed reductions and changes in course to avoid close approaches of animals.

In all project phases, all underway vessels operating at any speed must have a dedicated visual observer on duty at all times to monitor for protected species. For vessels operating at speeds greater than 10 knots, that observer/lookout must have no other duties during the period the vessel is traveling at speeds greater than 10 knots. Alternative monitoring technology, such as night vision and thermal cameras, will be available to ensure effective watch at night and in any other low visibility conditions.

Additionally, at all times of the year regardless of vessel size or type and regardless of location, visual observers must monitor a vessel strike avoidance zone (extending at least 500 m from the vessel) and if an animal is spotted, the vessel must slow down (to less than 10 knots if traveling above, and to the slowest speed that allows for safe movement) and take action to transit safely around the animal. Monitoring measures also include the integration of sighting communication tools such as Mysticetus, Whale Alert, and WhaleMap to establish a situational awareness network for marine mammal and sea turtle detections. To minimize risk to sea turtles, if a sea turtle is sighted within 100 meters or less of the operating vessel's forward path, the vessel operator is required to slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 meters at which time the vessel may resume normal operations. Additionally, vessel captains/operators must avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas.

7.2.3 Assessment of Risk of Vessel Strike – Construction, Operations and Maintenance, and Decommissioning

Here, we consider the risk of vessel strike to ESA listed species. This assessment incorporates the vessel strike avoidance measures identified in Section 3.0, because they are considered part of the proposed action or are otherwise required by regulation. This analysis is organized by species group (i.e., Atlantic sturgeon, shortnose sturgeon, whales, and sea turtles) because the risk factors and effectiveness of strike avoidance measures are different for the different species groups. Within the species groups, the effects analysis is organized around the different geographic areas where project related vessel traffic would be experienced.

As noted in section 2 of this Opinion and further addressed below, the effects of some vessel transits have been addressed in other Biological Opinions. Specifically, some Atlantic Shores South project vessels will utilize the Paulsboro Marine Terminal in Paulsboro, NJ, the New

Jersey Wind Port in Hope Creek, NJ, and the Repauno Terminal in Gibbstown, NJ, which were constructed pursuant to USACE permits. The Biological Opinions prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023, "2023 Paulsboro Opinion"), New Jersey Wind Port (February 25, 2022, "2022 NJWP Opinion"), and Repauno Terminal (December 8, 2017, "2017 Repauno Opinion") considered effects of vessels transiting to/from these ports on shortnose sturgeon, Atlantic sturgeon and critical habitat designated for the New York Bight DPS of Atlantic sturgeon.

Each of these three Biological Opinions analyzed an overall amount of vessel transits, of which Atlantic Shores South would contribute a small part. The effects analyzed in the three completed port Opinions have been considered as part of the *Environmental Baseline* of this Opinion, given the definition of that term at 50 CFR §402.02. The effects specific to Atlantic Shores South's vessel use of those ports will be discussed here in this *Effects of the Action* section by referencing the analysis in three port Opinions and determining whether the effects of Atlantic Shores South's vessels transiting to and from those ports are consistent with those analyses or anticipated to cause additional effects. As previously explained, by using this methodology, this Opinion ensures that all of the effects of Atlantic Shores South's vessel transits to and from the ports analyzed in other Biological Opinions will be considered in the *Integration and Synthesis* section and reflected in this Opinion's final determination under ESA 7(a)(2). This methodology also ensures this Opinion does not "double-count" effects of Atlantic Shores South's vessel transits to and from the ports–once in the Environmental Baseline and once here in this Opinion's *Effects of the Action* section. This approach is being taken because BOEM was not a party to the three port Biological Opinions' consultation process, yet Atlantic Shores South's vessel transits would not occur but for BOEM's proposed COP approval with conditions; additionally, the three port Opinions do not identify specific users of the ports.

7.2.3.1 Atlantic Sturgeon

The distribution of Atlantic sturgeon does not overlap with the entirety of the action area. The marine range of Atlantic sturgeon extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida with distribution largely from shore to the 50m depth contour (ASMFC 2006; Stein et al. 2004). Atlantic sturgeon may occur in nearshore waters (depths less than 50 m) and some rivers and bays that may be transited by Project vessels, including the WDA. Atlantic sturgeon occur along the estuarine/riverine portions of the vessel transit routes used by vessels transiting Delaware Bay and Delaware River (Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno), and the Chesapeake Bay (Portsmouth, Virginia). Atlantic sturgeon do not occur in the Gulf of Mexico.

Vessel Operations in the Lease Area, Cable Corridor, and to/from the Atlantic City O&M Facility

While Atlantic sturgeon are known to be struck and killed by vessels in rivers and in estuaries adjacent to spawning rivers (i.e., Delaware Bay), we have no reports of vessel strikes in the marine environment. We have considered whether Atlantic sturgeon are likely to be struck by project vessels or if the increase in vessel traffic is likely to otherwise increase the risk of strike for Atlantic sturgeon in the lease area, along the cable corridor and during transits to and from the O&M Facility in Atlantic City, NJ. As established elsewhere in this Opinion, Atlantic sturgeon use of the WDA (i.e., the lease area and cable corridors) is intermittent and dispersed;

there are no aggregation areas in the area in the WDA, the cable corridors or along the vessel transit route to Atlantic City. Additionally, these transit routes are not adjacent to, or within, any spawning rivers, which would increase the number and concentration of migrating Atlantic sturgeon. Atlantic sturgeon are not known to occur in the nearshore/inland waters where the O&M facility will be located. The dispersed nature of Atlantic sturgeon in this area means that the potential for co-occurrence between a project vessel and an Atlantic sturgeon in time and space is extremely low.

In order to be struck by a vessel, an Atlantic sturgeon needs to co-occur with the vessel hull or propeller in the water column. Given the depths in the vast majority of the this area (with the exception of near shore areas where vessels will dock and noting that Atlantic sturgeon are not expected to occur in the Atlantic City area) and that sturgeon typically occur at or near the bottom while in the marine environment, the potential for co-occurrence of a vessel and a sturgeon in the water column is extremely low even if a sturgeon and vessel co-occurred generally. The areas to be transited by the project vessels are free flowing with no obstructions; therefore, even in the event that a sturgeon was up in the water column such that it could be vulnerable to strike, there is ample room for a sturgeon swim deeper to avoid a vessel or to swim away from it which further reduces the potential for strike. The nearshore Atlantic City port area where vessels will enter shallower water and dock is not known to be used by Atlantic sturgeon; as such, co-occurrence between any Atlantic sturgeon and any project vessels in areas with shallow water or constricted waterways where the risk of vessel strike is theoretically higher, is extremely unlikely to occur. Considering this analysis, it is extremely unlikely that any project vessels operating in the Atlantic Shores South lease area, along the cable corridor, or between these areas and the O&M facility in Atlantic City will strike an Atlantic sturgeon during any phase of the proposed project.

Effects of Vessel Transits to Ports in Delaware River/Bay and Portsmouth, VA
Vessels traveling along the Atlantic coast between the lease area and ports in the Delaware River/Bay, and Portsmouth will transit past a number of Atlantic sturgeon aggregation areas or "hot spots"; however, these vessels will be transiting in deeper, more offshore waters and not actually pass through any of these areas. As such, the risk to Atlantic sturgeon from the oceanic portions of these trips is the same as identified for the marine environment above; that is, it is extremely unlikely that any Atlantic sturgeon will be struck by project vessels operating in the Atlantic Ocean on the way to/from any of these ports.

As explained in sections 2.0 and 7.2.3 of this Opinion and above, NMFS completed ESA section 7 consultations on the construction and use of the Paulsboro Marine Terminal, New Jersey Wind Port, and the Repauno Terminal.

<u>New Jersey Wind Port (NJWP)</u>
In the February 25, 2022, Biological Opinion issued to USACE for the construction and operation of the NJWP, NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to jeopardize any DPS of Atlantic sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of 35 Atlantic sturgeon (23 New York Bight DPS, 5 Chesapeake Bay DPS, 5 South Atlantic DPS, 2 Gulf of Maine DPS) as a result of vessel strike. The Opinion

calculated these mortalities based on 1,280 vessel trips annually during the 25-year operational life of the port (approximately 32,000 total trips). In the BA for the Atlantic Shores South project, BOEM estimates up to 1,250 trips to the NJWP (Table 1-9 in the BA) during the construction phase and up to 32 trips during the O&M phase, and another 1,250 trips during decommissioning, for a total of 2,532 trips. This is approximately 8% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 8% of the total vessel strikes of Atlantic sturgeon could result from Atlantic Shores South vessels. Calculating 8% of 35 Atlantic sturgeon results in an estimate of 2.8 vessel struck sturgeon. As such, we anticipate that vessels using the NJWP as part of the Atlantic Shores South project will result in the strike of no more than three Atlantic sturgeon. Considering the apportionment of take by DPS outlined in the February 2022 Opinion, we expect that two of these would be from the New York Bight DPS with one from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS.

<u>Paulsboro Marine Terminal</u>
In the November 7, 2023, Biological Opinion issued to USACE for the construction and operation of the Paulsboro Marine Terminal, NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize any DPS of Atlantic sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of eight Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 2 from the Chesapeake Bay DPS, 1 from the South Atlantic DPS, and 1 from the Gulf of Maine DPS). The Opinion calculated this mortality based on a maximum of 880 vessel trips from 2023-2032. In the BA for the Atlantic Shores South project, BOEM estimates up to 122 trips to the Paulsboro Marine Terminal (Table 1-9 in the BA) during the construction and O&M phases. This is approximately 14% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, Atlantic Shores South vessels are similar to the vessels described in the Paulsboro Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 14% of the total vessel strikes of Atlantic sturgeon could result from Atlantic Shores South vessels. Calculating 14% of 8 Atlantic sturgeon results in an estimate of 1.12 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Atlantic Shores South project will result in the strike of no more than two Atlantic sturgeon. Based on the proportional assignment of take in the November 2023 Paulsboro Opinion, we expect that these are likely to be Atlantic sturgeon belonging to the New York Bight DPS.

<u>Repauno Terminal</u>
In the BA for the Atlantic Shores South project, BOEM estimates up to 20 trips to Repauno during construction, 1 during O&M, and up 20 during decommissioning for a total of up to 41 trips. This is approximately 1% of the total trips considered in the 2017 Repauno Opinion.

Based on the available information, Atlantic Shores South vessels are similar to the vessels considered in that Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. In the December 8, 2017, Biological Opinion issued to USACE for the construction and operation of the Repauno Terminal, NMFS concluded that the construction and use of the Terminal was likely to adversely affect but not likely to jeopardize any DPS of Atlantic sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Repauno Terminal during 30 years of port operations will result in the mortality of 6 Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 1 from the Chesapeake Bay DPS, 1 from the Chesapeake Bay or Gulf of Maine DPS). The Opinion calculated this mortality based on an estimate of 133 trips per year for the 30-year life of the terminal (3,990 trips total). As explained in section 6 of this Opinion, using an updated vessel strike rate of 0.0091 Atlantic sturgeon strikes/Delaware River vessel trip, we calculate that Atlantic Shores' vessels would strike and kill up to 0.37 Atlantic sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal Repauno facility will strike and kill no more than one Atlantic sturgeon. Based on the proportional assignment of take in the 2017 Opinion, which is consistent with the best available information on the genetic makeup of Atlantic sturgeon in the Delaware River, we expect that this will be a New York Bight DPS Atlantic sturgeon.

Portsmouth Marine Terminal, VA

Vessels traveling to or from the port facilities at Portsmouth would travel from the lower Chesapeake Bay to the Port of Virginia/Hampton Roads along the Elizabeth River where the Portsmouth Marine Terminal is located. Vessels are expected to travel within the Federal navigation channels from the confluence of the Chesapeake Bay with the Atlantic Ocean to the Port. Large vessels, such as the Atlantic Shores South project vessels, that enter the Elizabeth River are typically assisted by tug boats and travel at speeds of less than 1 knot with their propeller idling. The Port of Virginia is made up of over 55 public and private marine terminals. The port received over 2,300 vessel calls in 2019[47]. This does not account for Naval vessels, which are estimated at 1 to 8 transits per day or recreational boats (over 2,000 registered in the City of Portsmouth, VA) (USCG 2016). Thousands of other vessels annually transit the Chesapeake Bay entrance channels traveling to and from other ports within Chesapeake Bay, including the Port of Baltimore and ports in the James River. The USCG's 2021 Port Access Route Study for Approaches to the Chesapeake Bay, VA (USCG 2021, Enclosure 1), reports annual transits of the Chesapeake Bay entrance of 12,192 in 2017, 15,947 in 2018, and 16,811 in 2019 for an average of 14,983 annual transits through the mouth of Chesapeake Bay.

In the BA, BOEM estimates that up to 20 vessel trips to Portsmouth could occur during construction, 1 during O&M, and up to 20 during decommissioning. Considering that construction and decommissioning will each occur over at least two years, we expect no more than 10 trips between the WDA and Portsmouth in a single year. This represents less than 0.4% of the annual vessel traffic to the Port of Virginia and less than 0.07% of the annual transits through the mouth of Chesapeake Bay. We also note that as the vessels will be using existing port facilities, this may not represent an actual increase in vessel traffic in the area (i.e., while these particular trips would not occur but for the Atlantic Shores project, other vessels would

[47] https://hamptonroadsalliance.com/port-of-virginia/; last accessed November 20, 2023

transit to/from Portsmouth if these trips did not occur).

Through the Sturgeon Salvage Program, we keep records of Atlantic sturgeon carcasses that are reported by researchers and the public. From June 2013 through December 2020, 89 carcasses were reported in the Virginia waters of the Chesapeake Bay with approximately 70 of those records having injuries consistent with vessel strike; from September 2021 – May 2023, 32 carcasses were reported from that area (NMFS unpublished data). Of these 121 reports, 1 carcass was observed in the Elizabeth River. We do not expect that all vessel struck sturgeon are observed and reported; thus, the salvage data represents a minimum estimate of total vessel strikes. However, based on the available information, vessel strike within the Elizabeth River appears to be rare; this is likely due to the rarity of Atlantic sturgeon in the Elizabeth River and the slow movement of vessels in this area (as described above). We also note that we do not know if the reported carcass was actually struck in the Elizabeth River or if it floated in from the James River. The available carcass recovery information suggests that Atlantic sturgeon are struck in the lower James River and also likely struck near the confluence of the James River with the Chesapeake Bay (as we only have information on carcass recovery location, we do not typically know where a strike actually occurred). While Atlantic Shores vessels will transit through areas where Atlantic sturgeon vessel strikes are expected to occur, these vessels will make up an extremely small percentage of the traffic in this area (less than 0.07%). As such, assuming a proportional risk to Atlantic sturgeon, any risk of these vessels striking an Atlantic sturgeon is extremely small and approaching zero. Therefore, we have determined that vessel strike of an Atlantic sturgeon from an Atlantic Shores vessel transiting to/from Portsmouth, VA is extremely unlikely to occur and effects are discountable.

Summary

In summary, considering all vessel traffic over the life of the project, we anticipate vessel traffic related to the Atlantic Shores South project to cause the mortality of 6 Atlantic sturgeon (5 from the New York Bight DPS and 1 from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS). This take and its effects have been evaluated in the above referenced Biological Opinions issued by NMFS to the USACE for Repauno, the NJWP, and Paulsboro Marine Terminal.

Critical Habitat Designated for the New York Bight DPS of Atlantic sturgeon

The action area overlaps with a portion of the Delaware River critical habitat unit designated for the New York Bight DPS. The only project activity that may affect this critical habitat is the transit of project vessels to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately RKM 139), the Repauno Terminal in Gibbstown, NJ (approximately RKM 139), and the New Jersey Wind Port in Hope Creek, NJ (approximately RKM 84).

The Biological Opinions prepared by NMFS for the Paulsboro, Repauno, and New Jersey Wind Ports considered effects of construction of these port facilities and the effects of all vessels transiting between the mouth of Delaware Bay and these ports on critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon; the same conclusion was reached in NMFS December 8, 2017 Biological Opinion for the Repauno Terminal. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to affect critical habitat at the NJWP. While we are not able to determine the proportional effects of Atlantic Shores South vessel use of the NJWP on critical habitat we have determined that because the number of trips and vessel types are consistent with the activities described in the NJWP Opinion, effects to critical habitat are also within the scope of effects considered in that Opinion. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the Environmental Baseline for the Atlantic Shores South project. We have not identified any effects of the Atlantic Shores South project on critical habitat designated for the New York Bight DPS of Atlantic sturgeon that are beyond what was considered in the Paulsboro, Repauno, and New Jersey Wind Port consultations.

7.2.4.2 Shortnose sturgeon

The only portion of the action area that overlaps with the distribution of shortnose sturgeon is a portion of the vessel transit routes within the Delaware River/Bay. While shortnose sturgeon occur in some areas of the Chesapeake Bay, they are not known to occur in the portion of the Chesapeake Bay that will be transited by vessels traveling between the WDA and Portsmouth. Shortnose sturgeon do not occur in the Gulf of Mexico.

Effects of Vessel Transits to Portsmouth, VA

Vessels traveling to or from Portsmouth, VA would travel from the lower Chesapeake Bay to the Port of Norfolk along the Elizabeth River. Shortnose sturgeon are not known to occur in the lower Chesapeake Bay where vessels would transit to Portsmouth and are not known to occur in the Elizabeth River. As such, we do not anticipate any co-occurrence between shortnose sturgeon and project vessels in this portion of the action area; therefore, exposure to project vessels transiting to/from Portsmouth are not expected to occur. No effects to shortnose sturgeon from these vessel transits are anticipated.

Effects of Vessel Transits to Ports in Delaware River

Shortnose sturgeon occur in the portion of the Delaware River that would be transited by vessels moving to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately river kilometer 139), Repauno Terminal in Gibbstown, NJ (just downstream of Paulsboro), and the New Jersey Wind Port in Hope Creek, NJ (approximately river kilometer 84). The Biological Opinions prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023, “2023 Paulsboro Opinion”), New Jersey Wind Port (February 25, 2022, “2022 NJWP Opinion”), and Repauno Terminal (December 8, 2017, “2017 Repauno Opinion”) considered effects of vessels transiting between the mouth of Delaware Bay and these ports on shortnose sturgeon. Each of these three Biological Opinions analyzed an overall amount of vessel transits, of which Atlantic Shores South would contribute a small part.

New Jersey Wind Port
In the 2022 NJWP Biological Opinion[48] NMFS concluded that the construction and subsequent use of the New Jersey Wind Port by visiting vessels was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of four shortnose sturgeon as a result of vessel strike. The Opinion calculated these mortalities based on 1,280 annual vessel trips during the 25-year operational life of the port (32,000 total trips). In the BA for the Atlantic Shores South project, BOEM estimates up to 1,250 trips to the NJWP (Table 1-9 in the BA) during the construction phase and up to 32 trips during the O&M phase, and another 1,250 trips during decommissioning, for a total of 2,532 trips. This is approximately 8% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike a shortnose sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 8% of the total vessel strikes of shortnose sturgeon could result from Atlantic Shores South vessels. Calculating 8% of 4 Atlantic sturgeon results in an estimate of 0.32 vessel struck sturgeon. As such, we anticipate that vessels using the NJWP as part of the Atlantic Shores South project will result in the lethal strike of up to one shortnose sturgeon.

Paulsboro
In the November 7, 2023, Biological Opinion issued to USACE for the construction and operation of the Paulsboro Marine Terminal, NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of 1 shortnose sturgeon. The Opinion calculated this mortality based on a maximum of 880 vessel trips from 2023-2032. In the BA for the Atlantic Shores South project, BOEM estimates up to 122 trips to the Paulsboro Marine Terminal (Table 1-9 in the BA) during the construction and O&M phases. This is approximately 14% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike a sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 14% of the total vessel strikes of shortnose sturgeon could result from Atlantic Shores South vessels. Calculating 14% of 1 shortnose sturgeon results in an estimate of 0.14 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Atlantic Shores South project will result in the lethal strike of up to one shortnose sturgeon.

[48] The USACE has requested reinitiation of the 2022 NJWP Opinion. However, NMFS has requested that the USACE provide additional information necessary for the analysis and reinitiation of the consultation may not commence until NMFS receives that information. Until a new biological opinion is produced, the 2022 NJWP Opinion remains the best analysis of effects on listed species and critical habitat due to NJWP construction and use.

Repauno Terminal
In the December 8, 2017, Biological Opinion issued to USACE for the construction and operation of the Repauno Terminal, NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Terminal during 30 years of port operations will result in the mortality of 1 shortnose sturgeon. The Opinion calculated this mortality based on an estimate of 133 trips per year for the 30-year life of the terminal (3,990 trips total). In the BA for the Atlantic Shores South project, BOEM estimates up to 20 trips to Repauno during construction, 1 during O&M, and up 20 during decommissioning for a total of up to 41 trips. This is approximately 1% of the total trips considered in the Repauno Opinion. Based on the available information, we expect that Atlantic Shores South vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike a sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 1% of the total vessel strikes of shortnose sturgeon could result from Atlantic Shores South vessels. Calculating 1% of 1 shortnose sturgeon results in an estimate of 0.01 vessel struck sturgeon. Given that the estimate is approaching zero, we consider it extremely unlikely that an Atlantic Shores vessel transiting within the Delaware River/Bay will strike a shortnose sturgeon.

In summary, considering all vessel traffic over the life of the project, we anticipate vessel traffic related to the Atlantic Shores South project to cause the mortality of two shortnose sturgeon. This take has been evaluated in the above referenced Biological Opinions issued by NMFS to the USACE for the NJWP and Paulsboro Marine Terminal.

7.2.3.2 ESA Listed Whales

Background Information on the Risk of Vessel Strike to ESA Listed Whales
Vessel strikes of large whales from all sizes of commercial, recreational, and military vessels have resulted in serious injury and fatalities to the ESA listed whales that occur in the action area as described in more detail in Section 6.1 (Environmental Baseline) (Lammers et al. 2003, Douglas et al. 2008, Laggner 2009, Berman-Kowalewski et al. 2010, Calambokidis 2012). Records of collisions date back to the early 17th century, and the worldwide number of collisions appears to have increased steadily during recent decades (Laist et al. 2001, Ritter 2012).

The most vulnerable marine mammals are those that spend extended periods at the surface feeding or in order to restore oxygen levels within their tissues after deep dives. Mother/calf pairs are at high risk of vessel strike because they frequently rest and nurse in nearshore habitats at or near the water surface, particularly in the Southeast calving area (Cusano et al. 2018; Dombroski et al. 2021). A summary of information on the risk of vessel strike to right whales is found in Garrison et al. 2022. Baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek et al. 2004). Many studies have been conducted analyzing the impact of vessel strikes on whales; these studies suggest that a greater rate of mortality and serious injury to large whales from vessel strikes correlates with greater vessel speed at the time of a ship strike (Laist et al.

2001, Vanderlaan and Taggart 2007 as cited in (Aerts and Richardson 2008)). Numerous studies have indicated that slowing the speed of vessels reduces the risk of lethal vessel collisions, particularly in areas where right whales are abundant and vessel traffic is common and otherwise traveling at high speeds (Vanderlaan and Taggart 2007; Conn and Silber 2013; Van der Hoop et al. 2014; Martin et al. 2016; Crum et al. 2019). Vessels transiting at speeds >10 knots present the greatest potential hazard of collisions (Jensen and Silber 2004, Silber et al. 2009). Vanderlann and Taggart (2007) demonstrated that between vessel speeds of 8.6 and 15 knots, the probability that a vessel strike is lethal increases from 21% to 79%. In assessing records with known vessel speeds, Laist et al. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (13 kn). NMFS' data on documented vessel strike events continues to affirm the role of high vessel speeds (> 10 knots (5.1 m/s)) in lethal collision events and supports existing studies implicating speed as a factor in lethal strikes events (87 FR 46921). While it remains unclear how whales generally, and right whales in particular, respond to close approaches by vessels (<460 m) and the extent to which this allows them to avoid being struck, Conn and Silber (2013) indicated that encounter rates were higher with fast-moving vessels than expected, which may be consistent with successful avoidance of slower vessels by whales.

Large whales also do not have to be at the water's surface to be struck. In a study that used scale models of a container ship and a right whale in experimental flow tanks designed to characterize the hydrodynamic effects near a moving hull that may cause a whale to be drawn to or repelled from the hull, Silber et al. (2010) found when a whale is below the surface (about one to two times the vessel draft), there is likely to be a pronounced propeller suction effect. This modeling suggests that in certain circumstances, particularly with large, fast moving ships and whales submerged near the ship, this suction effect may draw the whale closer to the propeller, increasing the probability of propeller strikes. Additionally, Kelley et al (2020) found that collisions that create stresses in excess of 0.241 megapascals were likely to cause lethal injuries to large whales and through biophysical modeling that vessels of all sizes can yield stresses higher than this critical level. NMFS' data on documented vessel strike events continues to affirm the role of high vessel speeds (> 10 knots (5.1 m/s)) in lethal collision events and supports existing studies implicating speed as a factor in lethal strikes events. Growing evidence shows that vessel speed, rather than size, is the greater determining factor in the severity of vessel strikes on large whales; vessels less than 65 ft. in length accounted for 5 of the 12 documented lethal strike events of North Atlantic right whales in U.S. waters since 2008 (87 FR 46921). Of the six lethal vessel strike cases documented in U.S. waters and involving right whales since 1999 where vessel speed is known, only one involved a vessel transiting at under 10 knots (5.1 m/s) (87 FR 46921).

Reducing vessel speed is one of the most effective, feasible options available to reduce the likelihood of lethal outcomes from vessel collisions with right whales (87 FR 46921). In an effort to reduce the likelihood and severity of fatal collisions with right whales, NMFS established vessel speed restrictions in specific locations, primarily at key port entrances, and during certain times of the year, these areas are referred to as Seasonal Management Areas (SMA). A 10-knot speed restriction applies to vessels 65 feet and greater in length operating within any SMA (73 FR 60173, October 10, 2008). As noted above, NMFS has published proposed modifications to these regulations that would increase the scope of the speed restrictions including application of mandatory speed restrictions in some areas and times of year for smaller vessels than in the existing rule (87 FR 46921; August 1, 2022). That regulation has not been finalized and the potential effects of those regulations are not evaluated in this opinion.

In the 2008 regulations, NMFS also established a Dynamic Management Area (DMA) program whereby vessels are requested, but not required, to either travel at 10 knots or less or route around locations when certain aggregations of right whales are detected outside SMAs. These temporary protection zones are triggered when three or more whales are visually sighted within 2-3 miles of each other outside of active SMAs. The size of a DMA is larger if more whales are present. A DMA is a rectangular area centered over whale sighting locations and encompasses a 15-nautical mile buffer surrounding the sightings' core area to accommodate the whales' movements over the DMA's 15-day lifespan. The DMA lifespan is extended if three or more whales are sighted within 2-3 miles of each other within its bounds during the second week the DMA is active. Only verified sightings are used to trigger or extend DMAs; however, DMAs can be triggered by a variety of sources, including dedicated surveys, or reports from mariners. Acoustically triggered Slow Zones were implemented in 2020 to complement the visually triggered DMAs. The protocol for the current acoustic platforms that are implemented in the Slow Zone program specify that 3 upcalls must be detected (and verified by an analyst) to consider right whales as "present" or "detected" during a specific time period. Acknowledging that visual data and acoustic data differ, experts from NMFS' right whale Northeast Implementation Team, including NEFSC and Woods Hole Oceanographic Institute staff, developed criteria for accepting detection information from acoustic platforms. To indicate right whale presence acoustically (and be used for triggering notifications), the system must meet the following criteria: (1) evaluation has been published in the peer-reviewed literature, (2) false detection rate is 10% or lower over daily time scales and (3) missed detection rate is 50% or lower over daily time scales. For consistency, acoustically triggered Slow Zones are active for 15 days when right whales are detected and can be extended with additional detections. However, acoustic areas are established by rectangular areas encompassing a circle with a radius of 20 nautical miles around the location of the passive acoustic monitoring system.

In an analytical assessment of when the vessel restrictions were and were not in effect, Conn and Silber (2013) estimated the speed restrictions required by the ship strike rule reduced total ship strike mortality by 80 to 90%. In 2020, NMFS published a report evaluating the conservation value and economic and navigational safety impacts of the 2008 North Atlantic right whale vessel speed regulations. The report found that the level of mariner compliance with the speed rule increased to its highest level (81%) during 2018-2019. In most SMAs more than 85% of vessels subject to the rule maintained speeds under 10 knots, but in some portions of SMAs mariner compliance is low, with rates below 25% for the largest commercial vessels outside four ports in the southeast. Evaluations of vessel traffic in active SMAs revealed a reduction in vessel speeds over time, even during periods when SMAs were inactive. An assessment of the voluntary DMA program found limited mariner cooperation that fell well short of levels reached in mandatory SMAs. The report examined AIS-equipped vessel traffic (<65 ft. in length, not subject to the rule) in SMAs, in the four New England SMAs, more than 83% of all <65 ft. vessel traffic transited at 10 knots or less, while in the New York, Delaware Bay, and Chesapeake SMAs, less than 50% of transit distance was below 10 knots. The southern SMAs were more mixed with 55-74% of <65 ft. vessel transit distance at speeds under 10 knots (NMFS 2020). The majority of AIS-equipped <65 ft. vessel traffic in active SMAs came from four vessel types: pleasure, sailing, pilot, and fishing vessels (NMFS 2020).

The Atlantic Shores South WDA does not overlap with any SMAs, however, the vessel transit routes to a number of ports overlap with a number of Mid-Atlantic SMAs. Project vessels transiting to ports in Delaware River/Bay, Portsmouth, VA, and Corpus Christi, TX will travel through or adjacent to SMAs near the mouth of Delaware Bay, Chesapeake Bay, near Morehead City, NC and along the coast from Wilmington, NC to Charleston, SC. These Mid-Atlantic SMAs are in effect from November 1 - April 30 each year. Project vessels traveling to Corpus Christi will also travel through the Southeast SMA along the coast from Brunswick, GA to St. Augustine, GA which is in effect from November 15 – April 15 each year. Additionally, DMAs and acoustically triggered Slow Zones have been established in response to aggregations of right whales in the waters of Mid-Atlantic, and may overlap vessel transit routes and/or the lease area throughout the year. For example, in 2022, NMFS declared a total of 77[49] DMAs/Right Whale Slow Zones along the U.S. East Coast. Of these, 30 were triggered by right whale sightings and 47 were triggered by acoustic detections. DMAs/Slow Zones were declared in 11 locations in the Northeast/Mid-Atlantic U.S. (Martha's Vineyard, MA, Virginia Beach, VA, Portsmouth, NH, Nantucket, MA, Boston, MA, Chatham, MA, Portland, ME, Ocean City, MD, New York Bight, NY, Atlantic City, NJ and Cape Cod Bay, MA) and in one location in the Southeast U.S. (Ocracoke, NC). As elaborated on below, BOEM will require that Atlantic Shores South vessels of any size travel at speeds of 10 knots or less in any SMA or DMA/Slow Zone in all project phases; this requirement is also included in the proposed MMPA ITA for its 5-year operative period.

Exposure Analysis – ESA Listed Whales

We consider vessel strike of ESA listed whales in the context of specific project phases because the characteristics and volume of vessel traffic is distinctly different during the three phases of the project. Vessels trips between the WDA and ports in NJ, VA, and TX will occur during the construction phase. The majority of traffic during all phases will be between the lease area and the O&M facility in Atlantic City, NJ (approximately 72% during construction and decommissioning and 98% during operations). Table 7.2.1 above details the vessel trips to U.S. ports during the construction phase of the project.

For our risk assessment, we first considered the best available information on strikes of right, fin, sei, and sperm whales in the geographic area under consideration (i.e., the area where vessel traffic will occur), including considerations of cryptic mortality (i.e., the number of animals that are killed and never observed). Second, we used the best available information on baseline traffic (i.e., the annual number of vessel transits within a particular geographic area absent the proposed action) and the information provided by BOEM and Atlantic Shores South on the number of anticipated vessel transits in that area by Atlantic Shores South project vessels to determine to what extent vessel traffic would increase in the area during each of the three phases of the Atlantic Shores South project. For example, if baseline traffic in a particular area were 100 trips per year and the Atlantic Shoes South project would result in 10 new trips in that area,

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[49] https://www.fisheries.noaa.gov/s3/2023-01/2022_DMAs_and_Right_Whale_Slow_Zones_508.pdf; last accessed November 14, 2022.

we would conclude that traffic was likely to increase by 10%. Third, based on the assumption that risk of vessel strike is related to the amount of vessel traffic (i.e., that more vessels operating in a geographic area would lead to a proportional increase in vessel strike risk), we considered how the increase in baseline vessel strikes may increase as a result of the increase in vessel traffic. Finally, we considered the risk reduction measures that are part of the proposed action and whether, with those risk reduction measures in place, any vessel strike was reasonably certain to occur.

The numbers of baseline vessel transits and Project vessel transits were used to evaluate the effects of vessel traffic on listed species as this provides the most accurate representation of vessel traffic in the region and from the proposed Project. As explained above, baseline vessel transits were estimated using vessel AIS density data (number of trips) which provides a quantifiable comparison and approximation to estimate risk to listed species from the increase in Project vessel traffic. We considered an approach using vessel-miles; however, we have an incomplete baseline of vessel traffic in the region in the terms of vessel miles, as there is significant variability in vessel-mileage between vessel type and activity and no reliable way to obtain vessel miles from the existing baseline data we have access to. While data on the miles that project vessels will travel is partially available, without a robust baseline to compare it to, we are not able to provide an accurate comparison to baseline traffic levels. Further, given that we are considering the area within which the vessels will operate (i.e., evaluating risk along particular vessel routes) we do not expect that the results of our analysis would be any different even if we did have the information necessary to evaluate the increase in vessel traffic in the context of miles traveled rather than number of trips. Based on this foregoing reasoning, using vessel trips results is a more accurate assessment of the risk of adding the Atlantic Shores vessels to the baseline than could have been carried out using vessel miles and we consider it the best available information for conducting the vessel strike risk analysis.

Vessel Operations in the Lease Area, Along the Cable Routes and To/From Ports in NJ
ESA listed whales use portions of the action area throughout the year, including the portion of the action area where vessels will transit in the lease area, along the Atlantic Shores South export cable corridors, and between those locations and identified ports in NJ (see Section 5 and 6 for more information on distribution of whales in the action area). Baseline vessel traffic in the action area is described at the beginning of this section. Vessel traffic between the lease area/cable corridors and ports in NJ accounts for 72-100% of the anticipated vessel traffic during the construction phase (dependent on the actual ports used) and 98% of the anticipated traffic during the operations phase.

From the marine mammal stock assessment reports and serious injury and mortality reports produced by NMFS, for the period of 1999-2020 (the most recent period available), we identified a total of four records of ESA listed whales with injuries consistent with vessel strike that were first detected in waters from Rehoboth, DE to Barnegat Inlet, NJ which is the best representation of the geographic area representing the lease area, the cable corridor, and the area where vessels will transit between these areas and the identified ports in NJ (Table 7.2.1 below). Considering the 1999-2020 stock assessment reports and serious injury and mortality reports as well as available information through November, 2023, we did not identify any records of right or sperm whales struck in this portion of the action area. We also did not identify any additional reports of vessel strikes for fin or sei whales in this area.

Considering the information presented in the available Serious Injury and Mortality Reports for 1999-2021 (as cited below) and information on the right whale UME from June 6, 2017 – November 30, 2023[50], there were no North Atlantic right whales reported with vessel strike injuries between Rehoboth Beach, DE and Barnegat Inlet, NJ (the area where the vast majority of project vessel traffic will occur). We note that right whales with evidence of vessel strike are reported in waters outside this area during this time-period. The closest reported vessel strike of a right whale to the area considered here is the reported vessel strike of a male calf near Elberon, NJ in June 2020 by a vessel traveling at approximately 28 knots (approximately 112 km north of Atlantic City, NJ) (Henry et al. 2022).

Table 7.2.3. Information on ESA listed whales reported with injuries consistent with vessel strikes between Rehoboth, DE and Barnegat Inlet, NJ from 1999-2021.

ESA listed Whales with Injuries Consistent with Vessel Strikes		
Species	Total	Date and Location
Fin Whale	3	7/2/08 Barnegat Inlet, NJ; 9/23/10 Cape Henlopen State Park, DE; 1/23/12 Ocean City, NJ
Sei Whale	1	5/7/14 Delaware River (on ship's bow)

Source: Henry et al. 2023 (2017-2021 data), Henry et al. 2022 (2016-2020 data); Henry et al. 2017 (2011-2015); Glass et al. 2012 (2006-2010); Nelson et al. 2007 (2001-2005 data); Cole et al. 2005 (1999-2000 data)

These mortalities were reported over a 23-year period (1999-2021). It is important to note that the locations recorded are, in nearly all cases, the area where the whale was first sighted and the actual location of the strike is unknown. For example, the sei whale recorded above was documented when the vessel came into port in the Delaware River; it is unknown where along the vessel's transit route the strike actually occurred. Considering these strikes over a 23-year period, this is an annual average reported strike rate of 0.13 fin whales, and 0.04 sei whales. Though this is a relatively small number of vessel strikes for the period, detection of carcasses is very difficult given the large open ocean, which means that this could be an underestimate. Conversely, the location of a recovered carcass is where it was first detected, not necessarily where the incident occurred, and some of the incidents detected in this area may be whales that were struck outside of the area, which would result in an overestimate of the strikes that occurred in the area. Additionally, depending on cetacean species, carcasses may be more likely to float or sink, they may be carried from where they were struck on the bow of a vessel and only noticed in port, or carried away from the ship strike location by wind, currents, and waves. All of these factors contribute to the difficulty in detecting carcasses, in particular from ship strike (Rockwood et al. 2017).

A number of studies have estimated carcass recovery rates for different cetacean species, including 17% for right whales, 6.5% for killer whales, <5% for grey whales, and 3.4% for sperm whales (Kraus et al. 2005). Pace et al. (2021) used an abundance estimation model to derive estimates of cryptic mortality for North Atlantic right whales and found that observed

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[50] 1https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event; last accessed 11/26/23

carcasses accounted for 36% of all estimated deaths during 1990–2017 (Pace et al. 2021). As increased search effort and stranding response in recent years would suggest a higher rate might apply now for right whales, the 36% rate is considered the best available estimate of carcass recovery for the time series considered here (2000-2021). These rates are largely related to how buoyant a species is, thus affecting how likely it will be detected. Right whales are the most buoyant species due to their thick blubber layer, and are most likely to be detected, thus providing a conservative estimate for extrapolation. Sperm whale buoyancy depends on lung inflation at mortality; near the surface, they have positive buoyancy, but overall negative tissue buoyancy (Rockwood et al. 2017). To determine an improved recovery rate estimate for other whale species relative to right whales, Rockwood et al. 2017 used an average of the sperm, grey, and killer whale rates.

Using the 5% rate (mean of sperm, grey, and killer whales) for fin and sei whales, we extrapolated ship strike mortality from the 1999-2021 serious injury/mortality data to produce an estimate of the total number of fin, and sei whales struck annually in the geographic area under consideration (i.e., Rehoboth Beach to Barnegat Inlet) as shown below. The calculation used is: ((total individuals detected in the geographic area of interest with injuries consistent with vessel strike)/(correction factor))/number of years of detection data. Using this formula, we calculate:

Fin whales: (3/0.05)/23 = 2.61/year
Sei whales: (1/0.05)/23 = 0.87/year

Considering right and fin whales, absent any mitigation measures we would expect an increase in risk proportional to the increase in vessel traffic. As such, this would increase risk during the construction period by 2.3%, during the operational period by 2.5%, and 2.3% during the decommissioning period. As noted above, there are no records of right whales with evidence of vessel strike where the first observation was in waters where nearly all project vessel traffic will occur. There are 3 records of fin whales and 1 sei whale with injuries consistent with vessel strike first detected in this area; though, as noted above, the location of the strike is unknown. Sei and sperm whales are typically found in deeper waters of the continental shelf, and are expected to be rare in the Atlantic Shores WDA and even less likely to occur in the nearshore/inland portions of the action area where vessels will transit between coastal ports and the Atlantic Shores WDA. Thus, any potential increase in risk of strike of sei and sperm whales is even smaller.

There are a number of factors that result in us determining that any potential increase in vessel strike is extremely unlikely to occur. As described above, a number of measures designed to reduce the likelihood of striking marine mammals including ESA listed large whales, particularly North Atlantic right whales, are included as part of the proposed action. These measures include seasonal speed restrictions and enhanced monitoring via PSOs, PAM, and alternative monitoring technologies.

The vessel speed limit requirements proposed by Atlantic Shores South, BOEM, and NMFS OPR are in accordance with measures outlined in NMFS Ship Strike Reduction Strategy as the best available means of reducing ship strikes of right whales and are consistent with the changes proposed to vessel size in the recent proposed rule; that is, they limit speed to 10 knots or less for all vessels in areas and times when right whales are most likely to occur. As described in Section 3.0 of this Opinion, during the 5-year effective period of the IHA, between November 1 and April 30, all project vessels of all sizes will be required to operate at 10 knots or less. After that time, vessels of any size will only be able to exceed 10 knots if they are outside of an SMA or DMA and are traveling within a transit corridor monitored by a PAM system specifically designed for the project area to detect right whales and no right whales have been documented within the previous 12 hour period. Additionally, vessels of all sizes will be required to reduce speeds to 10 knots or less in any SMA or DMA, regardless of time of year. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. In rulemaking, NMFS has concluded, based on the best available scientific evidence, that a maximum speed of 10 knots, as measured as "speed over ground", in certain times and locations, is the most effective and practical approach to reducing the threat of ship strikes to right whales.

Absent any information to the contrary, we assume that a 10-knot speed restriction similarly reduces the risk to other whale species. Substantial evidence (Laist et al., 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007; Kelley et al. 2020) indicates that vessel speed is an important factor affecting the likelihood and lethality of whale/vessel collisions. In a compilation of ship strikes of all large whale species that assessed ship speed as a factor in ship strikes, Laist et al. (2001) concluded that a direct relationship existed between the occurrence of a whale strike and the speed of the vessel. These authors indicated that most deaths occurred when a vessel was traveling at speeds of 14 knots or greater and that, as speeds declined below 14 knots, whales apparently had a greater opportunity to avoid oncoming vessels. Adding to the Laist et al. (2001) study, Jensen and Silber (2003) compiled 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Vessel speed at the time of the collision was reported for 58 of those cases; 85.5 percent of these strikes occurred at vessel speeds of 10 knots or greater. Effects of vessel speed on collision risks also have been studied using computer simulation models to assess hydrodynamic forces vessels have on a large whale (Knowlton et al., 1995; Knowlton et al., 1998). These studies found that, in certain instances, hydrodynamic forces around a vessel could act to pull a whale toward a ship. These forces increase with increasing speed and thus a whale's ability to avoid a ship in close quarters may be reduced with increasing vessel speed. Related studies by Clyne (1999) found that the number of simulated strikes with passing ships decreased with increasing vessel speeds, but that the number of strikes that occurred in the bow region increased with increasing vessel speeds. Additionally, vessel size has been shown to be less of a significant factor than speed, as biophysical modeling has demonstrated that vessels of all sizes can yield stresses likely to cause lethal injuries to large whales (Kelley et al. 2020). The speed reduction alone provides a significant reduction in risk of vessel strike as it both provides for greater opportunity for a whale to evade the vessel but also ensures that vessels are operating at such a speed that they can make evasive maneuvers in time to avoid a collision.

A number of measures will be in place to maximize the likelihood that during all times of the year and in all weather conditions that if whale is in the vicinity of a project vessel that the whale is detected, the captain can be notified and measures taken to avoid a strike (such as slowing down further and/or altering course). Although some of these measures have been developed to specifically reduce risk of vessel strike with right whales, all of these measures are expected to provide the same protection for other large whales as well. These measures apply regardless of the length of the transit and include dedicated PSOs or lookouts on all Project vessels during all phases to monitor the vessel strike avoidance zone and requirements to slow down less than 10 knots if a whale is spotted, alternative visual detection systems (e.g., thermal cameras) stationed on all transiting vessels that intend to operate at greater than 10 knots, and additional measures as outlined in Section 3.0. These measures are meant to increase earlier detection of whale presence and subsequently further increase time available to avoid a strike. Awareness of right whales in the area will also be enhanced through monitoring of reports on USCG Channel 16, communication between project vessel operators of any sightings, and monitoring of the NMFS Right Whale Sightings Advisory System.

Here, we explain how these measures support our determination that any hypothetical increase in vessel strike is extremely unlikely to occur. Many of these measures are centered on vessel speed restrictions and increased monitoring. To avoid a vessel strike, a vessel operator both needs to be able to detect a whale and be able to slow down or move out of the way in time to avoid collision. The speed limits and monitoring measures that are part of the proposed action maximize the opportunity for detection and avoidance.

Vessel speed restrictions:

As outlined in the BA, with the exception of crew transport vessels and some other support vessels, project vessels will normally transit at 10 knots or less. During the five year effective period of the MMPA ITA, from November 1 – April 30, all project vessels, regardless of size, will be required to travel at speeds less than 10 knots; year-round any vessels transiting within any SMA or DMA/Slow Zone will also be limited to 10 knots. Following the expiration of the MMPA ITA, from November 1 – April 30 all vessels except CTVs will be required to travel at speeds less than 10 knots with CTVS only being allowed to travel over 10 knots when they are outside an SMA or DMA and are traveling within a transit corridor being monitored by PAM and no right whales have been detected in the previous 12 hours. The November – April period is the time of year when right whales are most likely to occur in the area transited by project vessels and covers the months when density is highest.

As described in Section 3.0, BOEM and NMFS OPR are proposing to require that in order for vessels traveling within the lease area or cable corridors and between the lease area and ports, including the O&M facility in Atlantic City, to go over 10 knots, a PAM system must be deployed in the transit corridor. Specifically, in the transit corridor and the lease area a semi-permanent acoustic network comprising near real-time bottom mounted and/or mobile acoustic monitoring platforms will be installed such that confirmed right whale detections are regularly transmitted to a central information portal and disseminated through the situational awareness network. The transit corridor and WDA will be divided into detection action zones; localized detections of right whales 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. This condition would apply to areas or times of year not already covered by the speed reduction requirements in place for SMAs and DMAs.

Vessels would also be required to slow to 10 knots or less any time a large whale (any species) is observed within 500 m of a vessel. All vessels, regardless of size, would immediately reduce speed to 10 kts or less when a North Atlantic right whale is sighted, at any distance, by an observer or anyone else on the vessel.

By reducing speeds below 10 knots, the probability of a lethal ship strike is greatly reduced; additionally, reduced speeds provide greater time to react if a PSO/lookout observes an animal in the path of a vessel and therefore reduces the likelihood of any strike occurring at all. With the exception of the CTVs and some support vessels, project vessels are expected to never, or rarely, operate at speeds over 10 knots (for a complete list of vessels and operating speeds see table 3.x). These measures presented below will be implemented for vessels that would otherwise travel at speeds above 10 knots.

Exceptions to 10 knot speed restriction:
Project vessels may travel at speeds greater than 10 knots at certain times of the year and in certain geographic areas. Project vessels may travel at speeds above 10 knots from May 1 – October 31 if the vessel is not transiting through a DMA/Slow Zone or a speed restriction for a transit corridor has not been triggered by PAM detections. After the 5-year effective period of the MMPA ITA, CTVs can travel above 10 knots from November 1 to April 30 only if they are not transiting through a DMA/Slow Zone or a speed restriction for a transit corridor has not been triggered by PAM detections. The period of time and areas when vessels can travel at speeds greater than 10 knots are at times when right whales are expected to occur in very low numbers and/or when area specific monitoring (i.e., PAM within a transit corridor) has not detected any right whales, and thus the risk of a vessel strike is significantly lower. Additionally, during the construction phase when there is the greatest amount of project vessel traffic, travel above 10 knots will only occur from May 1 – October 31 and in areas with PAM when no right whales have been detected in the previous 12 hours, which decreases the potential for a vessel traveling greater than 10 knots to co-occur with a right whale (as described in further detail below). In all instances, PSOs/lookouts will be monitoring a vessel strike zone, see below.

PSOs/Lookouts and Increased right whale awareness:

A number of measures will be required by BOEM and/or NMFS OPR to increase awareness and detectability of whales. Vessel operators and crews will receive protected species identification training that covers species identification as well as making observations in good and bad weather. All vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course (as appropriate) and regardless of vessel size, to avoid striking any marine mammal. During any vessel transits within or to/from the Atlantic Shores South WDA, an observer would be stationed at the best vantage point of the vessel(s) to ensure that the vessel(s) are maintaining the appropriate separation distance from protected species. A PSO or crew lookout must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species. During vessel transits over 10 knots, these lookouts will have no other duty than to monitor for listed species. If a whale is sighted, the lookout will communicate to the vessel captain to slow down and take measures to avoid the sighted animal. Visual observers will also be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog, etc.). At all times the lookout will be monitoring for presence of whales and ensuring that the vessel stays at least 500 m away from any right whale or unidentified large whale. If any whale is detected within 500 m of the vessel, speed will be reduced to less than 10 knots; if any right whale is observed within any distance from the vessel, speed will be reduced to less than 10 knots.

Year-round, all vessel operators will monitor the project's Situational Awareness System, WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales once every 4-hour shift during project-related activities. The PSO and PAM operator monitoring teams for all activities will also monitor these systems no less than every 12 hours. If a vessel operator is alerted to a North Atlantic right whale detection within the project area, they will immediately convey this information to the PSO and PAM teams. All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (DMAs/Slow Zones and SMAs) and daily information regarding right whale sighting locations. Active monitoring of right whale sightings information provides situational awareness for monitoring of right whales in the area of vessel activities.

Passive Acoustic Monitoring:

As noted above, PAM monitoring in the lease area and the vessel transit routes is required for vessels to be able to operate above 10 knots (noting that PAM monitoring will not provide an exception to speed reductions in SMAs or DMAs). If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all vessels must travel at 10 knots or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 12 hours. This increases detectability beyond the area that an observer can see and enhances the effectiveness of required vessel avoidance measures.

In summary, we expect that despite the increase in vessel traffic that will result from the proposed action, the multi-faceted measures that will be required of all Project vessels will enable the detection of any ESA listed whale that may be in the path of a Project vessel with enough time to allow for vessel operators to avoid any such whales. Combined with the already very low increased risk of vessel strike anticipated due to increased project vessel traffic, we expect that these measures will make it extremely unlikely that a Project vessel will strike a fin, sei, sperm, or right whale; thus, effects of vessel traffic in this area are discountable. No take is anticipated.

Effects of Vessel Transits to Portsmouth and Corpus Christi

Atlantic Shoes South anticipates up to 20 vessel trips to Portsmouth and/or up to 20 trips to Corpus Christi over the 3-year construction phase of the project. As described in Section 6.0, ESA listed whales occur in this area in varying distribution and abundance throughout the year. North Atlantic right whales occur in the area along coastal waters as they migrate through the Mid-Atlantic to the Southeast calving grounds, primarily in the fall and early spring. Fin whales most commonly occur throughout the year in offshore waters of the northern Mid-Atlantic. Sei whales typically are found offshore along the shelf break throughout the year, primarily in northern Mid-Atlantic waters. Sperm whales along the Mid-Atlantic and the Gulf of Mexico are found offshore along the shelf break year-round. In general, ESA listed whales are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in offshore waters.

As explained above, over 74,000 vessel transits a year occur in the area surrounding the WDA. Given the presence of large ports in the South Atlantic, we expect similar levels of baseline vessel traffic along the coast south of Delaware Bay to Charleston (i.e., over 74,000 transits within the area annually). Considering the potential trips to Portsmouth and Corpus Christi, this would be an increase in vessel traffic of no more than 0.002% in that 3-year period. Additionally, the multi-faceted measures, including 10-knot speed restrictions for vessels traveling to/from these ports in the November – April period, will enable the detection of any ESA listed whale that may be in the path of a Project vessel with enough time to allow vessel operators to avoid any such whales. We expect that these measures will make it extremely unlikely that a Project vessel will strike a whale.

In summary, while there is an increase in risk of vessel strike during all phases of the proposed project due to the increase in vessel traffic, because of the measures that will be in place, particularly the vessel speed restrictions and use of enhanced monitoring measures, we do not expect that this increase in risk will result in a vessel strike caused by the action. Based on the best available information on the risk factors associated with vessel strikes of large whales (i.e., vessel size and vessel speed), and the measures required to reduce risk, it is extremely unlikely that any project vessel will strike a right, fin, sei, or sperm whale during any phase of the proposed project and the effects of vessel strike on whales is thus discountable. No take is anticipated.

7.2.3.3 Sea Turtles

Background Information on the Risk of Vessel Strike to Sea Turtles
While research is limited on the relationship between sea turtles, ship collisions, and ship speeds, sea turtles are at risk of vessel strike where they co-occur with vessels. Sea turtles are vulnerable to vessel collisions because they regularly surface to breathe, and often rest at or near the surface. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged (Renaud and Carpenter 1994; Sasso and Witzell 2006). Although, Hazel et al. (2007) demonstrated sea turtles preferred to stay within the three meters of the water's surface, despite deeper water being available. Any of the sea turtle species found in the action area can occur at or near the surface in open-ocean and coastal areas, whether resting, feeding or periodically surfacing to breathe. Therefore, all ESA listed sea turtles considered in the biological opinion are at risk of vessel strikes.

A sea turtle's detection of a vessel is likely based primarily on the animal's ability to see the oncoming vessel, which would provide less time to react to as vessel speed increases (Hazel et al. 2007), however, given the low vantage point of a sea turtle at the surface it is unlikely they are readily able to visually detect vessels at a distance. Hazel et al. (2007) examined vessel strike risk to green sea turtles and suggested that sea turtles may habituate to vessel sound and are more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in eliciting responses (Hazel et al. 2007). Regardless of what specific stressor associated with vessels turtles are responding to, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007). This is a concern because faster vessel speeds also have the potential to result in more serious injuries (Work et al. 2010). Although sea turtles can move quickly, Hazel et al. (2007) concluded that at vessel speeds above 4 km/hour (2.1 knots) vessel operators cannot rely on turtles to actively avoid being struck. Thus, sea turtles are not considered reliably capable of moving out of the way of vessels moving at speeds greater than 2.1 knots.

Stranding networks that keep track of sea turtles that wash up dead or injured have consistently recorded vessel propeller strikes, skeg strikes, and blunt force trauma as a cause or possible cause of death (Chaloupka et al. 2008). Vessel strikes can cause permanent injury or death from bleeding or other trauma, paralysis and subsequent drowning, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition at the time of injury. Much of what has been documented about recovery from vessel strikes on sea turtles has been inferred from observation of individual animals for some duration of time after a strike occurs (Hazel et al. 2007; Lutcavage et al. 1997). In the U.S., the percentage of strandings that were attributed to vessel strikes increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (USFWS 2007). In 1990, the National Research Council estimated that 50-500 loggerhead and 5-50 Kemp's ridley sea turtles were struck and killed by boats annually in waters of the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate.

Vessel strike has been identified as a threat in recovery plans prepared for all sea turtle species in the action area. As described in the Recovery Plan for loggerhead sea turtles (NMFS and USFWS 2008), propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9% of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. The proportion of vessel-struck sea turtles that survive is unknown. In some cases, it is not possible to determine whether documented injuries on stranded animals resulted in death or were post-mortem injuries. However, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles. Based on data from off the coast of Florida, there is good evidence that when vessel strike injuries are observed as the principle finding for a stranded turtle, the injuries were both ante-mortem and the cause of death (Foley et al 2019). Foley et al. (2019) found that the cause of death was vessel strike or probable vessel strike in approximately 93% of stranded turtles with vessel strike injuries. Sea turtles found alive with concussive or propeller injuries are frequently brought to rehabilitation facilities; some are later released and others are deemed unfit to return to the wild and remain in captivity. Sea turtles in the wild have been documented with healed injuries so at least some sea turtles survive without human intervention. As noted in NRC 1990, the regions of greatest concern for vessel strike are outside the action area and include areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico. In general, the overall risk of strike for sea turtles in the Northwest Atlantic is considered greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels (NRC 1990). This combination of factors in the action area is limited to nearshore areas in the southern extent of the action area, well outside the Atlantic Shores South WFA and the transit routes to Atlantic City where the vast majority of vessel traffic will occur.

Exposure Analysis – Sea Turtles

We consider vessel strike of ESA listed sea turtles in the context of specific project phases because the characteristics and volume of vessel traffic is distinctly different during the three phases of the project.

Transits in the Lease Area, Cable Corridor and to/from Ports in NJ
Here we consider the risk of vessel strike to sea turtles from project vessels transiting between the lease area/cable corridors and the identified ports in New Jersey. We queried the NMFS' Sea Turtle Stranding and Salvage Network (STSSN) database for records of sea turtles with injuries consistent with vessel strike (recorded as definitive vessel and blunt force trauma in the database) in New Jersey and Delaware from 2013 to 2022. We selected this geographic area as it represents the waters that will be transited by project vessels traveling to/from the lease area/cable corridors and the ports identified in NJ, inclusive of those in Delaware River/Bay and the O&M facility in Atlantic City. The results from this query are presented in Table 7.2.4.

While we recognize that some vessel strikes may be post-mortem, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles (Foley et al. 2019). Out of the 747 reported sea turtle stranding cases (excluding cold stuns) in the NJ and DE region during the 10-year time period (2013-2022) of data, there were 210 records of sea turtles recovered with definitive evidence from vessel strikes. In addition, there were 106 sea turtles with evidence from blunt force trauma, which indicates probable vessel collision. As anticipated based on abundance of turtle species in the area, the majority of these records are of loggerhead sea turtles.

Based on the findings of Foley et al. (2019) that found vessel strike was the cause of death in 93% of strandings with indications of vessel strike, we consider that 93% of the sea turtle strandings recorded as "definitive vessel" and "blunt force trauma" had a cause of death attributable to vessel strike. Therefore, to estimate the number of interactions where vessel strike was the cause of death we first added the number of "definitive vessel" and "blunt force trauma" cases to get a total number of sea turtle strandings with indications of vessel strike, and then calculated 93% of the total (e.g., for loggerheads, we first added the "definitive vessel" (70) and "blunt force trauma" (41) then multiplied that value (111) by 0.93 (=103)). The result is the number of turtles in the "total presumed vessel mortalities" column in Table 7.2.4.

Table 7.2.4. Preliminary STSSN cases from 2013 to 2022 with evidence of propeller strike or probable vessel collision in Delaware and New Jersey and estimated presumed vessel mortalities. Source STSSN

Delaware

Sea Turtles	Total Records	Definitive Vessel	Blunt Force Trauma	Total Presumed Vessel Mortalities*
Loggerhead	217	70	41	103
Green	9	2	3	5
Leatherback	15	9	3	11
Kemp’s	28	10	9	18

Source: STSSN (March 2023)
* 93% of the total of “definitive vessel” plus “blunt force trauma,” rounded to whole numbers

New Jersey

Sea Turtles	**Total Records**	**Definitive Vessel**	**Blunt Force Trauma**	**Total Presumed Vessel Mortalities***
Loggerhead	344	85	41	117
Green	29	12	1	12
Leatherback	32	11	1	11
Kemp’s	35	7	6	12

Source: STSSN (March 2023)
* 93% of the total of “definitive vessel” plus “blunt force trauma” rounded to whole numbers

The data in Table 7.2.4 reflect stranding records, which represent only a portion of the total at-sea mortalities of sea turtles. Sea turtle carcasses typically sink upon death, and float to the surface only when enough accumulation of decomposition gasses cause the body to bloat (Epperly et al. 1996). Though floating, the body is still partially submerged and acts as a drifting object. The drift of a sea turtle carcass depends on the direction and intensity of local currents and winds. As sea turtles are vulnerable to human interactions such as fisheries bycatch and vessel strike, a number of studies have estimated at-sea mortality of marine turtles and the influence of nearshore physical oceanographic and wind regimes on sea turtle strandings. Although sea turtle stranding rates are variable, they may represent as low as five percent of total mortalities in some areas but usually do not exceed 20 percent of total mortality, as predators, scavengers, wind, and currents prevent carcasses from reaching the shore (Koch et al. 2013). Strandings of dead sea turtles from fishery interaction have been reported to represent as low as seven percent of total mortalities caused at sea (Epperly et al. 1996). Remote or difficult to access areas may further limit the amount of strandings that are observed. Because of the low probability of stranding under different conditions, determining total vessel strikes directly from raw numbers of stranded sea turtle data would vary between regions, seasons, and other factors such as currents.

To estimate unobserved vessel strike mortalities, we relied on available estimates from the literature. Based on data reviewed in Murphy and Hopkins-Murphy (1989), only six of 22 loggerhead sea turtle carcasses tagged within the South Atlantic and Gulf of Mexico region were reported in stranding records, indicating that stranding data represent approximately 27 percent of at-sea mortalities. In comparing estimates of at-sea fisheries induced mortalities to estimates of stranded sea turtle mortalities due to fisheries, Epperly et al. (1996) estimated that strandings represented 7 to13 percent of all at-sea mortalities.

Based on these two studies, both of which include waters of the U.S. East Coast, stranding data likely represent 7 to 27 percent of all at-sea mortalities. While there are additional estimates of the percent of at-sea mortalities likely to be observed in stranding data for locations outside the action area (e.g., Peck ham et al. 2008, Koch et al. 2013), we did not rely on these since stranding rates depend heavily on beach survey effort, current patterns, weather, and seasonal factors among others, and these factors vary greatly with geographic location (Hart et al. 2006). Thus, based on the mid-point between the lower estimate provided by Epperly et al. (1996) of seven percent, and the upper estimate provided by Murphy and Hopkins-Murphy (1989) of 27 percent, we assume that the STSSN stranding data represent approximately 17 percent of all at sea mortalities. This estimate closely aligns with an analysis of drift bottle data from the Atlantic Ocean by Hart et al. (2006), which estimated that the upper limit of the proportion of sea turtle carcasses that strand is approximately 20 percent.

To estimate the annual average vessel strike mortalities corrected for unobserved vessel strike mortalities, we adjusted our calculated total presumed vessel mortality with the detection value of 17%. The resulting, adjusted number of vessel strike mortalities of each species for New Jersey and Delaware are presented in the "annual total presumed vessel mortalities" column in Table 7.2.5. In using the 17 percent correction factor, we assume that all sea turtle species and at-sea mortalities are equally likely to be represented in the STSSN dataset. That is, sea turtles killed by vessel strikes are just as likely to strand or be observed at sea and be recorded in the STSSN database (i.e., 17 percent) as those killed by other activities, such as interactions with fisheries, and the likelihood of stranding once injured or killed does not vary by species.

Delaware

Sea Turtles	Presumed Vessel Mortalities* Over 10 Years	Total Over 10 Years (17% detection rate)	Annual Total presumed vessel mortalities
Loggerhead	103	606	60.6
Green	5	29	2.9
Leatherback	11	65	6.5
Kemp's ridley	18	106	10.6

New Jersey

Sea Turtles	Presumed Vessel Mortalities* Over 10 Years	Total Over 10 Years (17% detection rate)	Annual Total presumed vessel mortalities

Loggerhead	117	688	68.8
Green	12	71	7.1
Leatherback	11	65	6.5
Kemp's ridley	12	71	7.1

Finally, assuming a proportional relationship between vessel strikes and vessel traffic, we considered the phase-specific increase in vessel traffic and increased the number of baseline strikes to account for the increase in project vessel traffic. During the construction and decommissioning periods, we used a combination of the Delaware and New Jersey data as this best represents the area where vessels will be transiting between the lease area/cable corridors and the ports in NJ, including those in Delaware River/Bay and Atlantic City. Thus, the formula used to generate the estimate of project vessel strikes over the construction and decommissioning periods is: (annual DE and NJ baseline strikes) (% increase in traffic)(years of project phase).

Construction = 2.3% increase in traffic for 3 years

Loggerhead sea turtles: (60.6 +69)(0.023)(3) = 8.9 loggerhead sea turtles

Green sea turtles: (3+7.1)(0.023)(3) = 0.70 green sea turtles

Leatherback sea turtles: (6.5 + 6.5)(0.023)(3) = 0.90 leatherback sea turtles

Kemp's Ridley sea turtles: (10.6 + 7.1)(0.023)(3) = 1.22 Kemp's Ridley sea turtles

Decommissioning = 2.3% increase in traffic for 2 years

Loggerhead sea turtles: (60.6+69)(0.023)(2) = 5.96 loggerhead sea turtles

Green sea turtles: (3+7.1)(0.023)(2) = 0.46 green sea turtles

Leatherback sea turtles: (6.5+6.5)(0.023)(2) = 0.6 leatherback sea turtles

Kemp's Ridley sea turtles: (10.6+7.1)(0.023)(2) = 0.81 Kemp's Ridley sea turtles

During the operations period, nearly all vessel transits will be between Atlantic City and the lease area/cable corridors. Thus, we only used the data from New Jersey as using Delaware and New Jersey would go beyond the geographic area where these trips will occur. Even using the New Jersey data likely overestimates the risk of vessel strike; the area between the lease and Atlantic City that could be transited by project vessels represents about 10% of the New Jersey coastline. Thus, we have considered that 10% of the total vessel strikes of sea turtles in New Jersey would occur in this area. The formula used to generate the estimate of project vessel strikes over the operational period is (10% annual NJ baseline strikes)(% increase in traffic)(years of project phase).

Operation = 2.5% increase in traffic for 35 years

Loggerhead sea turtles: (6.9)(0.025)(35) = 6.04 loggerhead sea turtles

Green sea turtles: (0.71)(0.025)(35) = 0.41 green sea turtles

Leatherback sea turtles: (0.65)(0.025)(35) = 0.56 leatherback sea turtles

Kemp's Ridley sea turtles: (0.71)(0.025)(35) = 0.41 Kemp's Ridley sea turtles

As explained above in Section 7.2.3, Atlantic Shores South is proposing to take and/or BOEM is proposing to require a number of measures designed to minimize the potential for strike of a protected species that will be implemented over the life of the project. These include reductions in speed in certain areas, including certain times of the year to minimize the risk of vessel strike of large whales, the use of trained look outs, slowing down if a sea turtle is sighted within 100 m of the operating vessel's forward path and if a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the individual at a speed of 4 knots or less, and seasonally avoiding transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). While we expect that these measures will help to reduce the risk of vessel strike of sea turtles, individual sea turtles can be difficult to spot from a moving vessel at a sufficient distance to avoid strike due to their low-lying appearance. With this information in mind, we expect that the risk reduction measures that are part of the proposed action will reduce collision risk overall but will not eliminate that risk. We are not able to quantify any reduction in risk that may be realized and expect that any reduction in risk may be small.

To determine the likely total number of sea turtles that will be struck by project vessels, we have added up the numbers for each phase then rounded up to whole animals. As such, based on our analysis, the proposed action is expected to result in vessel strike of sea turtles up to the number identified in Table 7.2.5 below:

Table 7.2.5. Estimate of sea turtle vessel strikes as a result of the proposed action.

Species	Vessel Strike
NWA DPS Loggerhead sea turtle	21
NA DPS green sea turtle	2
Leatherback sea turtle	2
Kemp's ridley sea turtle	3

While not all strikes of sea turtles are lethal, we have no way of predicting what proportion of strikes will be lethal and what proportion will result in recoverable injury. As such, for the purposes of this analysis given the likelihood of vessel strike to cause serious injury or mortality, it is reasonable to assume that all strikes will result in serious injury or mortality.

Effects of Vessel Transits to Portsmouth and Corpus Christi
In the BA, BOEM indicates that there may be up to 20 total round vessel trips to the Port of Portsmouth, VA during the construction phase and up to 20 total round vessel trips to Corpus

Christi, TX during the construction phase. These trips will occur over a 3-year period. Similar trips may also occur during decommissioning. Sea turtles are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in deeper offshore waters. Project vessels have the greatest chance to co-occur with sea turtles in the nearshore waters, near major ports, or in the shipping lanes. As explained above, over 74,000 vessel transits a year occur in the area within 40 nm of the lease. Given the presence of large ports in the South Atlantic, we expect similar levels of baseline vessel traffic along the coast south of Delaware Bay to Charleston (i.e., over 74,000 transits within the area annually). Considering the potential trips to Portsmouth and Corpus Christi, this would be an increase in vessel traffic of no more than 0.002% in that 3-year period. Based on this analysis, given the very small increase in vessel traffic and associated very small increase in subsequent risk, effects of this increase in traffic resulting in vessel strikes of sea turtles is extremely unlikely and thus discountable; and, the effect of adding the vessels to the baseline cannot be meaningfully measured, detected, or evaluated; therefore, effects are also insignificant.

7.2.3.4 Consideration of Potential Shifts in Vessel Traffic

Here, we consider how the proposed project may result in shifts or displacement of existing vessel traffic. As presented in the Navigational Risk Assessment ("NRA;" see COP Appendix II-S), the proposed WTG spacing is expected to be sufficient to allow the safe passage of vessels between the WTGs, and the directional trends of the vessel data are roughly in-line with the direction of the rows of WTGs as currently designed. However, transit through the lease area will be a matter of risk tolerance, and up to the individual vessel operators. While the presence of the WTGs and OSSs will not result in any requirements to reroute vessel traffic, it is possible that it will result in changes to vessel routes due to operator preferences and risk tolerances.

Based on AIS and other data presented in the NRA, vessel traffic in the lease area is primarily recreational vessels and fishing vessels, which transit the area in non-uniform patterns. Most deep draft (cargo/carriers and tankers) in the vicinity of the lease area take a route that passes to the east, but a fraction pass through the lease area while transiting between the Ambrose to Barnegat Traffic Lane and the Five Fathom Bank to Cape Henlopen Traffic Lane. Commercial fishing vessel traffic is also greater outside the lease than inside the lease area. Cruise ships and large ferries follow established routes to the east of the lease area en route to/from the Ambrose/Barnegat traffic lanes to the north of the lease area. Recreational boating activity is also greater in the nearshore waters to the west of the lease area than in the lease area itself. Most tug traffic near the lease area occurs between the lease area and the coast. In general, traffic is significantly higher in the summer and lowest in the winter.

As described in the NRA, it is anticipated that fishing and pleasure boat traffic will continue through the lease area following construction while deep draft ships (e.g., cargo/carrier, tankers, cruise ships) may route around to the east of the project (a more oceanward route) while tug/service vessels may modify routes around the project towards the west (coastal rates). Given that the vast majority of traffic in the lease area is already recreational and fishing vessels and that any changes in vessel transit routes for these categories of vessels are likely to be very small, if there are any changes at all, we expect the effects of any shifts to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore insignificant. Similarly, as primary traffic routes for other vessel types are also nearly all outside the lease area we expect any shifts in traffic to be very limited in scope. This small potential shift in traffic does not increase the risk of interaction with listed species as densities of listed species are not incrementally higher on the edges of the lease area where vessel traffic would theoretically shift to. As such, even if there is a shift in vessel traffic outside of the lease area or any other change in traffic patterns due to the construction and operation of the project, any effects to listed species would be so small that they would not be able to be meaningfully measured, evaluated, or detected and are therefore, insignificant.

7.2.4 Air Emissions Regulated by the OCS Air Permit

Atlantic Shores Offshore Wind has applied for an OCS Air Permit from the EPA. To date, EPA has not issued a proposed or draft OCS air permit. As described by EPA, the Outer Continental Shelf (OCS) Air Regulations, found at 40 CFR part 55, establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement, for facilities subject to the Clean Air Act (CAA) Section 328. Applicants within 25 nautical miles of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements. Applicants located beyond 25 nautical miles from the state seaward boundary are subject to federal air quality requirements and will likely need an OCS permit complying with the EPA's Prevention of Significant Deterioration (PSD) preconstruction permit program, and/or Part 71 Title V operating permit program requirements, and are subject to New Source Performance Standards and some standards for Hazardous Air Pollutants promulgated under Section 112 of the CAA.

The "potential to emit" for Atlantic Shores South OCS source's includes emissions from vessels installing the WTGs and the OSSs, engines on the WTGs and OSSs, as well as vessels that are at and are traveling within 25 miles to-and-from the windfarm during construction, operations and maintenance of the windfarm. Criteria air pollutant emissions and their precursors generated from the construction and operation of the windfarm include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter, and volatile organic compounds. These air pollutants are associated with the combustion of diesel fuel in a vessel's propulsion and auxiliary engines and the engine(s) located on WTGs and OSS. The BA notes that Atlantic Shores Offshore Wind must demonstrate compliance with the national ambient air quality standards (NAAQS). The NAAQS are health-based standards that the EPA sets to protect public health with an adequate margin of safety. Prevention of significant deterioration (PSD) increments. The PSD increments are designed to ensure that air quality in an area that meets the NAAQS does not significantly deteriorate from baseline levels.

In the BA, BOEM determined that the impact from air pollutant emissions is anticipated to be minor and short-term in nature. They determine that because EPA will require compliance with the NAAQS and the NAAQS are designed to ensure that air quality does not significantly deteriorate from baseline levels, it is reasonable to conclude that any effects to listed species from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are insignificant. At this time, there is no information on the effects of air quality on listed species that may occur in the action area. However, as the NAAQS and PSD increments are designed to ensure that air quality in the area regulated by the permit do not significantly deteriorate from baseline levels, it is reasonable to conclude that any effects to listed species from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are insignificant. Reinitiation of consultation may be required if permit terms and/or effects are likely to be different than anticipated.

7.3 Effects to Species during Construction

Here, we consider the effects of the proposed action on listed species from exposure to stressors as well as alterations or disruptions to habitat and environmental conditions caused by project activities during the construction phase of the project. Specifically, we address inter-array and export cable installation including the sea-to-shore transition, turbidity resulting from project activities including dredging, cable installation, foundation installation, and installation of scour protection, and project lighting during construction. Noise associated with these activities is discussed in section 7.1; associated vessel activities are discussed in section 7.2.

7.3.1 Cable Installation

As described in section 3, a number of cables will be installed as part of the Atlantic Shores South project. Activities associated with cable installation include seabed preparation, cable laying, and activities to support the sea to shore transition at the Atlantic landfall location in Atlantic City, New Jersey, and the Monmouth landfall location in Sea Girt, New Jersey. Effects of these activities are described here.

Atlantic Shores South is proposing to lay the inter-array cable and offshore export cable using cable installation equipment that would include either a jet plow, mechanical plow, mechanical cutting, or control flow excavation. Cable laying and burial may occur simultaneously using a lay and bury tool, or the cable may be laid on the seabed and then trenched post-lay. The burial method will be dependent on suitable seabed conditions and sediments along the cable route.

If seabed conditions do not permit burial of inter-array or offshore export cables, Atlantic Shores South is proposing to employ other methods of cable protection such as: (1) rock berms, (2) concrete mattresses, (3) frond mattresses, (4) rock bags, and (5) grout bags (Atlantic Shores COP 2023). Cable inspection would be carried out to confirm the cable burial depth along the route and to identify the need for any further remedial burial activities and/or secondary cable protection. Atlantic Shores South anticipates up to 5 percent of the export cable route would require secondary cable protection and that 15 percent of the entire IAC network would require secondary cable protection. Effects of habitat conversion resulting from cable protection are addressed in section 7.4.

The offshore export cables will connect with onshore export cables using HDD methodology. Up to three HDDs will be installed to support landfall of the export cables. Noise associated with installation and removal of the casing pipe and sheet pile goal posts is considered in section 7.1.

7.3.1.1 Pre-lay Grapnel Run and Boulder Relocation

Prior to installation of the cables, a pre-lay grapnel run (PLGR) would be performed to locate and clear obstructions such as abandoned fishing gear, UXOs, and other marine debris. Additionally, large boulders that cannot be avoided would be relocated from the cable path with a boulder grab tool. The boulder grab tool would be deployed from a remotely operated vehicle. The boulder grab tool would be lowered to the seabed over targeted boulders for relocation.

The pre-lay grapnel run will involve towing a grapnel, via the main cable-laying vessel, along the benthos of the cable burial route. During the pre-lay grapnel run, the cable-lay vessel will tow the grapnel at slow speeds (i.e., approximately 1 knot or less) to ensure all debris is removed. Given the very slow speed of the operation, any listed species in the vicinity are expected to be able to avoid the devices and avoid an interaction. Additionally, the cable for the grapnel run will remain taught as it is pulled along the benthos; there is no risk for any listed species to become entangled in the cable. For these reasons, any interaction between the pre-lay grapnel run or a boulder grab tool and ESA-listed species is extremely unlikely to occur. As any material moved during the pre-lay grapnel run and associated boulder relocation would be placed adjacent to the cable corridor any effects to listed species from these changes in the structure of the habitat are extremely unlikely to occur. As such, effects to listed species from these activities are discountable.

7.3.1.2 Cable Laying

Cable laying operations proceed at speeds of <1 knot. At these speeds, any sturgeon, sea turtle, or whale is expected to be able to avoid any interactions with the cable laying operation. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information effects caused by this activity, including entanglement of any species during the cable laying operation, are extremely unlikely to occur, and are therefore, discountable. Effects of turbidity from cable laying are considered below.

7.3.1.3 Seabed Preparation/Sand wave Leveling to Facilitate Cable Installation

Following the pre-lay grapnel run, dredging within the ECCs and WTA will occur where necessary to allow for effective cable laying through any identified sand waves. Generally, sand wave features are dynamic and have wavelengths that consist of hundreds of meters with heights of several meters and typically migrate several meters per day (Terwindt, 1971, Campmans et al., 2021). The leveling or clearance of tidal sand waves is needed prior to cable installation. Sand wave clearance volumes were estimated based on sand wave height, anticipated cable burial depth, the most likely cable installation technique, and the required clearance area. Atlantic Shores South anticipates that dredging would occur on sand waves where bedform thickness exceeds 0.7 meters within 98 feet of the final centerline of the ECC or IAC corridor. As noted in section 3, while the COP and BA indicate that a trailing suction hopper dredge may be used, during the consultation period BOEM indicated that a hopper dredge is not currently planned for use. As such, planned dredging methods anticipated for sand wave clearance are limited to a control flow excavator. As described in the BA, megaripple and sand wave leveling associated with the installation of the Atlantic Shores South projects will remove no more than 4,178,900 cubic yards (941,724 CY for the Atlantic Landfall Site and 3,237,176 CY for the Monmouth landfall site) of dredged material.

Use of a controlled flow excavator (CFE) is proposed for sand wave clearance. The CFE uses jets of water to move sand and does not come into contact with the substrate. Given that there is no contact with the substrate and sand is not entrained or otherwise removed through the CFE there is not expected to be any risk of impingement, entrainment, capture, or other sources of injury associated with the CFE. As such, effects to listed species from interactions with the CFE are extremely unlikely to occur and are discountable.

7.3.1.4 Sea to Shore Transition

As noted above, the offshore export cables will connect with the onshore export cable in Atlantic City, New Jersey and Sea Girt, New Jersey via HDD. The HDD methodology will involve drilling underneath the seabed and the intertidal area using a drilling rig positioned onshore within the landfall work area. To support HDD installation, an exit pit would be excavated at each of the two cable landfall sites. The exit pit would be approximately 30 m by 8 m (0.12 acres). The depth of HDD would depend on the soil conditions and final cable specifications. Excavation of the exit pit would be carried out with a mechanical dredge. Mechanical dredging entails lowering the open bucket or clamshell through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge or truck. The bucket operates without suction or hydraulic intake, moves relatively slowly through the water column, and impacts only a small area of the aquatic bottom at any time. In order to be captured in a dredge bucket, an animal must be on the bottom directly below the dredge bucket as it impacts the substrate and remain stationary as the bucket closes. Species captured in dredge buckets can be injured or killed if entrapped in the bucket or buried in sediment during dredging and/or when sediment is deposited into the dredge scow. Species captured and emptied out of the bucket can suffer stress or injury, which can lead to mortality.

Whales

As explained above, ESA listed whales are extremely unlikely to occur along the New Jersey coast where the sea to shore activities will take place, including any mechanical dredging. Therefore, we do not expect any ESA listed whales to be exposed to effects of dredging.

Sea Turtles

Sea turtles are seasonally present along the New Jersey coast and therefore, may be present in the area where mechanical dredging for the HDD exit pit occurs. Sea turtles are not known to be vulnerable to capture in mechanical dredges, presumably because they are able to avoid the dredge bucket. Thus, if a sea turtle were to be present at the dredge sites, it would be extremely unlikely to be captured, injured, or killed as a result of dredging operations carried out by a mechanical dredge, because of the anticipated behavioral response. That response, however, would likely be short and the sea turtle would resume its normal behavior without fitness consequences once it perceived it was safe. Based on this information, capture or collection of a sea turtle in a mechanical dredge is not expected. Any effects to individual sea turtles from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Atlantic Sturgeon

The risk of interactions between sturgeon and mechanical dredges is generally considered very low but is thought to be highest in areas where large numbers of sturgeon are known to aggregate. The risk of capture may also be related to the behavior of the sturgeon in the area. While foraging, sturgeon are at the bottom interacting with the sediment. This behavior may increase the susceptibility of capture with a dredge bucket. For entrapment to occur, an individual sturgeon would have to be present directly below the dredge bucket at the time of operation and be unable to escape. Mechanical dredging is a common activity throughout the range of Atlantic sturgeon and very few interactions have ever been recorded. Given that dredging will not occur in areas where few Atlantic sturgeon are anticipated to occur the co-occurrence of an Atlantic sturgeon and the dredge bucket is extremely unlikely. As such, entrapment or any interactions with sturgeon and the mechanical dredge is not expected. Any effects to individual sturgeon from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Jet Plowing during Cable Laying
The jet plow uses jets of water to liquefy the sediment, creating a trench in which the cable is laid. Cable laying operations proceed at speeds of <1 knot. At these speeds, any sturgeon, sea turtle, or whale is expected to be able to avoid any interactions with the cable laying operation. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information, adverse effects caused by this activity, including entanglement of any species during cable laying operation, are extremely unlikely to occur and thus discountable.

7.3.2 Turbidity from Cable Installation and Seafloor Preparation Activities
Installation of the ECCs and the IAC would disrupt bottom habitat and suspend sediment in the water column. Proposed equipment that would cause temporary increases in turbidity and sediment resuspension during cable installation include the use of a jet plow, mechanical plow, mechanical trench, and a CFE. As described in the Atlantic Shores South COP, hydrodynamic and sediment transport modeling was conducted to assess the sediment suspension and resulting deposition from proposed construction activities (see Appendix II-J3 for detailed descriptions). Sediment disturbance was evaluated for excavation of the HDD exit pit, installation of the cable using a jet-plow (in New Jersey State and Federal waters), and sand wave leveling for seafloor preparation with a CFE. Modeling was also carried out for hopper dredging; however, as hopper dredging is no longer planned, it will not be considered here.

As described in Atlantic Shores South COP Appendix II-J3:

- The suspended sediment plume from the proposed construction activities is transient and its location in relation to the sediment disturbance varies with the tidal cycles. The sediment plume is shown to be larger in areas where there are higher percentages of fine-grained surficial seafloor sediments.
- The excavation of the HDD exit pits using a mechanical (clamshell) dredge resulted in peak TSS concentrations of 10-25 milligrams per Liter (mg/L). This activity resulted in a 0.01 km^2 (2.47 acres) (1 hectare) (Monmonth) or 0.02 km^2 (4.94 acres) (2 hectares) (Atlantic) area on the seafloor where the deposition thickness was greater than 10 millimeters (mm) (0.4 inches (in)), extending a maximum of 102 m (335 ft.) (Monmouth) or 103 m (338 ft.) (Atlantic) from the source. The predicted time to return to ambient turbidity levels is 6 to 24 hours after completion for the Monmouth HDD pit and 6 to 12 hours after completion for the Atlantic HDD pit. The longer time to diminish to ambient conditions for the Monmouth HDD pit may be attributed to the sediments being released in deeper water, the higher fraction of fine sediments taking longer to settle, and slightly stronger currents transporting the sediments parallel to shore.

- For the Monmouth ECC installation, the maximum deposition thickness was between 10 and 20 mm, resulting in an area of deposition 0.02 km^2(4.94 acres, 2ha) having a thickness greater than 10 mm with a maximum extent of 30 m (98 ft.) from the route centerline. While the time to return to ambient turbidity levels will vary along the Monmouth ECC route, the time to return to ambient levels was between 12 and 24 hours after completion.
- The Atlantic ECC installation showed results with maximum deposition thickness of between 5 and 10 mm resulting in 1.39 km^2 (343.5 acres, 139 ha) having a thickness greater than 1 mm (0.04 in) with a maximum extent of 50 m (164 ft.) from the route centerline. While the time to return to ambient turbidity levels will vary along the Atlantic ECC route, the time to return to ambient levels was less than 6 hours after completion.
- Modeling of the IAC installation showed results with maximum deposition thickness less than 5 mm and the area with a thickness greater than 1 mm (0.04 in) ranged from 0.42 km^2 to 0.60 km^2 (103.8 acres to 148.3 acres, 42 ha to 60 ha). While the time to return to ambient turbidity levels will vary along the IAC route, the time to return to ambient levels was less than 6 hours after completion.
- Using CFE for sand wave leveling results in a maximum extent of deposition of sediment with thickness greater than 10 mm to be 165 m (541 ft.). The area of deposition having a thickness greater than 10 mm is 2.34 km^2 (234 ha, 578 ac) within the Monmouth ECC corridor.

Whales

In a review of dredging impacts to marine mammals, Todd et al. (2015) found that direct effects from turbidity have not been documented in the available scientific literature. Because whales breathe air, some of the concerns about impacts of TSS on fish (i.e., gill clogging or abrasion) are not relevant. Cronin et al. (2017) suggest that vision may be used by North Atlantic right whales to find copepod aggregations, particularly if they locate prey concentrations by looking upwards. However, Fasick et al. (2017) indicate that North Atlantic right whales certainly must rely on other sensory systems (e.g. vibrissae on the snout) to detect dense patches of prey in very dim light (at depths >160 meters or at night). Because ESA listed whales often forage at depths deeper than light penetration (i.e., it is dark), which suggests that vision is not relied on exclusively for foraging, TSS that reduces visibility would not be expected to affect foraging ability. Data are not available regarding whales avoidance of localized turbidity plumes; however, Todd et al. (2015) conclude that since marine mammals often live in turbid waters and frequently occur at depths without light penetration, impacts from turbidity are not anticipated to occur. As such, any effects to ESA listed whales from exposure to increased turbidity during cable installation are extremely unlikely to occur. If, in the extremely unlikely event that turbidity-related effects did occur, they would likely be so small that they cannot be meaningfully measured, evaluated, or detected and would therefore be insignificant. Effects to whale prey are considered below.

Sea Turtles

Similar to whales, because sea turtles breathe air, some of the concerns about impacts of TSS on fish (i.e., gill clogging or abrasion) are not relevant. There is no scientific literature available on the effects of exposure of sea turtles to increased TSS. Michel et al. (2013) indicates that since sea turtles feed in water that varies in turbidity levels, changes in such conditions are extremely unlikely to inhibit sea turtle foraging even if they use vision to forage. Based on the available information, we expect that any effects to sea turtles from exposure to increased turbidity during dredging or cable installation are extremely unlikely to occur and thus discountable. If, in the extremely unlikely event that turbidity-related effects did occur, they would likely be so small that they could not be meaningfully measured, evaluated, or detected and would therefore be insignificant. Effects to sea turtle prey are addressed below in section 7.3.4.1.

Atlantic sturgeon

Atlantic sturgeon are adapted to natural fluctuations in water turbidity through repeated exposure (e.g., high water runoff in riverine habitat, storm events) and are adapted to living in turbid environments (Hastings 1983, ECOPR Consulting 2009). Atlantic sturgeon forage at the bottom by rooting in soft sediments meaning that they are routinely exposed to high levels of suspended sediments. Few data have been published reporting the effects of suspended sediment on sturgeon. Garakouei et al. (2009) calculated Maximum Allowable Concentrations (MAC) for total suspended solids in a laboratory study with *Acipenser stellatus* and *A. persicus* fingerlings (7-10 cm TL). The MAC value for suspended sediments was calculated as 853.9 mg/L for *A. stellatus* and 1,536.7 mg/L for *A. persicus*. All stellate sturgeon exposed to 1,000 and 2,320 mg/L TSS for 48 hours survived. All Persian sturgeon exposed to TSS of 5,000, 7,440, and 11,310 mg/L for 48 hours survived. Given that Atlantic sturgeon occupy similar habitats as these sturgeon species, we expect them to be a reasonable surrogate for Atlantic sturgeon. Wilkens et al. (2015) contained young of the year Atlantic sturgeon (100-175 mm TL) for a 3-day period in flow-through aquaria, with limited opportunity for movement, in sediment of varying concentrations (100, 250 and 500 mg L^{-1} TSS) mimicking prolonged exposure to suspended sediment plumes near an operating dredge. Four-percent of the test fish died; one was exposed to 250 TSS and three to 500 TSS for the full three-day period. The authors concluded that the impacts of sediment plumes associated with dredging are minimal where fish have the ability to move or escape. As tolerance to environmental stressors, including suspended sediment, increases with size and age (ASMFC, 2012); we expect that the subadult and adults in the action area would be less sensitive to TSS than the test fish used in both of these studies.

Atlantic sturgeon that are located near the HDD exit pit during dredging or within 1 km of cable installation may be exposed to TSS above 100 mg/l; exposure above 1,000 mg/l is not expected for any activities. TSS plumes >100 mg/L could persist up to about 0.5 hours. Based on the information summarized above, any exposure to TSS would be below levels that would be expected to result in any effects to the subadult or adult Atlantic sturgeon occurring in the action area. As such, Atlantic sturgeon are extremely unlikely to experience any physiological or behavioral responses to exposure to increased TSS and these effects are thus discountable. Effects to Atlantic sturgeon prey are addressed below.

7.3.3 Impacts of Seabed Preparation and Cable Installation Activities on Prey

Here we consider the potential effects of sea bed preparation and cable installation on prey of whales, sea turtles, and Atlantic sturgeon due to impacts of sediment disturbance during dredging or cable laying and resulting exposure to increased TSS. We provide a brief summary of the prey that the various listed species forage on and then consider the effects of dredging and cable installation on prey, with the analysis organized by prey type. We conduct this analysis to consider whether listed species could be exposed to adverse effects due to adverse consequences to species on which they forage.

Summary of Information of Feeding of ESA-listed Species

Right whales

Right whales feed almost exclusively on copepods, a type of zooplankton. Of the different kinds of copepods, North Atlantic right whales feed especially on late stage *Calanus finmarchicus*, a large calanoid copepod (Baumgartner et al. 2007), as well as *Pseudocalanus spp*. and *Centropages spp*. (Pace and Merrick 2008). Because a right whale's mass is ten or eleven orders of magnitude larger than that of its prey (late stage *C. finmarchicus* is approximately the size of a small grain of rice), right whales are very specialized and restricted in their habitat requirements – they must locate and exploit feeding areas where copepods are concentrated into high-density patches (Pace and Merrick 2008).

Fin whales

Fin whales in the North Atlantic eat pelagic crustaceans (mainly euphausiids or krill, including *Meganyctiphanes norvegica* and *Thysanoessa inerrnis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes spp*.) (NMFS 2010). Fin whales feed by lunging into schools of prey with their mouth open, using their 50 to 100 accordion-like throat pleats to gulp large amounts of food and water. A fin whale eats up to 2 tons of food every day during the summer months.

Sei whales

An average sei whale eats about 2,000 pounds of food per day. They can dive 5 to 20 minutes to feed on plankton (including copepods and krill), small schooling fish, and cephalopods (including squid) by both gulping and skimming.

Sperm whales

Sperm whales hunt for food during deep dives with feeding occurring at depths of 500–1000 m depths (NMFS 2010). Deepwater squid make up the majority of their diet (NMFS 2010). Given the shallow depths of the area where the cable will be installed (less than 50 m), it is extremely unlikely that any sperm whales would be foraging in the area affected by the cable installation and extremely unlikely that any potential sperm whale prey would be affected by cable installation or dredging activities.

Sea turtles

Green sea turtles feed primarily on sea grasses and may feed on algae. Loggerhead turtles feed on benthic invertebrates such as gastropods, mollusks, and crustaceans. Diet studies focused on North Atlantic juvenile stage loggerheads indicate that benthic invertebrates, notably mollusks and benthic crabs, are the primary food items (Burke et al. 1993, Youngkin 2001, Seney 2003). Limited studies of adult loggerheads indicate that mollusks and benthic crabs make up their primary diet, similar to the more thoroughly studied neritic juvenile stage (Youngkin 2001). Kemp's ridleys primarily feed on crabs, with a preference for portunid crabs including blue crabs; crabs make up the bulk of the Kemp's ridley diet (NMFS et al. 2011).

Leatherback sea turtles feed exclusively on jellyfish. A study of the foraging ecology of leatherbacks off the coast of Massachusetts indicates that leatherbacks foraging off Massachusetts primarily consume the scyphozoan jellyfishes, *Cyanea capillata* and *Chrysaora quinquecirrha*, and ctenophores, while a smaller proportion of their diet comes from holoplanktonic salps and sea butterflies (*Cymbuliidae*) (Dodge et al. 2011); we expect leatherbacks in the Atlantic Shores South area to be foraging on similar species.

Atlantic sturgeon
Atlantic sturgeon are opportunistic benthivores that feed primarily on mollusks, polychaete worms, amphipods, isopods, shrimps and small bottom-dwelling fishes (Smith 1985, Dadswell 2006). A stomach content analysis of Atlantic sturgeon captured off the coast of New Jersey indicates that polycheates were the primary prey group consumed; although the isopod *Politolana concharum* was the most important individual prey eaten (Johnson et al. 2008). The authors determined that mollusks and fish contributed little to the diet and that some prey taxa (i.e., polychaetes, isopods, amphipods) exhibited seasonal variation in importance in the diet of Atlantic sturgeon. Novak et al. (2017) examined stomach contents from Atlantic sturgeon captured at the mouth of the Saco River, Maine and determined that American Sand Lance *Ammodytes americanus* was the most common and most important prey.

7.3.4.1 Effects on the Prey Base of ESA-listed Species in the Action Area

Dredging at the Sea to Shore Transition
To support HDD installation, the area around the landfall HDD exit pit will require dredging. The HDD exit pit will be excavated at each of the two landfall sites via use of a mechanical dredge, such as a long-reach excavator or a clamshell bucket dredge. The exit pit will be approximately 30 m by 8 m (0.12 acres). The only ESA listed species expected to forage in the areas where dredging will occur are sea turtles or Atlantic sturgeon that may forage opportunistically if there were suitable forage present. Dredging will result in a temporary loss of benthic prey in the areas being dredged and may result in the temporary burial of benthic resources as a result of sediment displacement. However, given that this area is rarely used for foraging, the areas impacted are very small, and any losses of benthic resources will be small and temporary, effects to Atlantic sturgeon and sea turtles are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and will be insignificant. The discussion that follows focuses on effects to prey along the cable routes outside of the areas at the HDD exit pit.

Use of CFE for Seabed Preparation
A CFE will be used along the cable route and at some foundation locations to level the sea bed in preparation for cable or foundation installation. The CFE moves sediment but does not pull sediment in like a cutterhead or hopper dredge does. As such, the use of the CFE is not expected to result in the capture, impingement, or entrainment of any prey items. Some benthic invertebrates could be buried; those effects are addressed below.

Exposure to Increased Turbidity

Copepods

Copepods exhibit diel vertical migration; that is, they migrate downward out of the euphotic zone at dawn, presumably to avoid being eaten by visual predators, and they migrate upward into surface waters at dusk to graze on phytoplankton at night (Baumgartner and Fratantoni 2008; Baumgartner et al. 2011). Baugmartner et al. (2011) concludes that there is considerable variability in this behavior and that it may be related to stratification and presence of phytoplankton prey with some copepods in the Gulf of Maine remaining at the surface and some remaining at depth. Because copepods even at depth are not in contact with the substrate, we do not anticipate any burial or loss of copepods during installation of the cable. We were unable to identify any scientific literature that evaluated the effects to marine copepods of exposure to TSS. Based on what we know about effects of TSS on other aquatic life, it is possible that high concentrations of TSS could negatively affect copepods. However, given that: the expected TSS levels are below those that are expected to result in effects to even the most sensitive species evaluated; the sediment plume will be transient and temporary (i.e., persisting in any one area for no more than 0.4 hours); elevated TSS is only expected near the bottom of the water column; and will occupy only a small portion of the WFA at any given time, any effects to copepod availability, distribution, or abundance on foraging whales would be so small that they could not be meaningfully evaluated, measured, or detected. Therefore, effects are insignificant.

Fish

As explained above, elevated TSS will be experienced along the cable corridor during cable installation and associated dredging and sandwave leveling. Anticipated TSS levels are below the levels expected to result in the mortality of fish that are preyed upon by fin or sei whales or Atlantic sturgeon. In general, fish can tolerate at least short-term exposure to high levels of TSS. Wilber and Clarke (2001) reviews available information on the effects of exposure of estuarine fish and shellfish to suspended sediment. In an assessment of available information on sublethal effects to non-salmonids, they report that the lowest observed concentration–duration combination eliciting a sublethal response in white perch was 650 mg/L for 5 d, which increased blood hematocrit (Sherk et al. 1974 in Wilber and Clarke 2001). Regarding lethal effects, Atlantic silversides and white perch were among the estuarine fish with the most sensitive lethal responses to suspended sediment exposures, exhibiting 10% mortality at sediment concentrations less than 1,000 mg/L for durations of 1 and 2 days, respectively (Wilber and Clarke 2001). Forage fish in the action area will be exposed to maximum TSS concentration-duration combinations far less than those demonstrated to result in sublethal or lethal effects of the most sensitive non-salmonids for which information is available. Based on this, we do not anticipate the mortality of any forage fish; therefore, we do not anticipate any reduction in fish as prey for fin or sei whales or Atlantic sturgeon and effects to these species are extremely unlikely to occur and discountable.

Benthic Invertebrates

In the BA, BOEM indicates that an area approximately 98-feet wide along the cable corridors will be disturbed during cable installation; this is likely to result in the mortality of some benthic invertebrates. Immediately following cable installation, this area will likely be devoid of any benthic invertebrates. However, given the narrow area, we expect recolonization to occur from adjacent areas that were not disturbed; therefore, this reduction in potential forage will be temporary.

As explained above, elevated TSS will be experienced along the cable corridors during cable installation. Because polychaete worms live in the sediment, we do not expect any effects due to exposure to elevated TSS in the water column. Wilbur and Clarke (2001) reviewed available information on effects of TSS exposure on crustacean and report that in experiments shorter than 2 weeks, nearly all mortality of crustaceans occurred with exposure to concentrations of suspended sediments exceeding 10,000 mg/L and that the majority of these mortality levels were less than 25%, even at very high concentrations. Wilbur and Clarke (2001) also noted that none of the crustaceans tested exhibited detrimental responses at dosages within the realm of TSS exposure anticipated in association with dredging. Based on this information, we do not anticipate any effects to crustaceans resulting from exposure to TSS associated with cable installation. Given the thin layer of deposition associated with the settling of TSS out of the water column following cable installation we do not anticipate any effects to benthic invertebrates. Based on this analysis, we expect any impact of the loss of benthic invertebrates to foraging Kemp's ridley and loggerhead sea turtles and Atlantic sturgeon due to cable installation to be so small that they cannot be meaningfully measured, evaluated, or detected and, therefore, are insignificant.

Jellyfish
A literature search revealed no information on the effects of exposure to elevated TSS on jellyfish. However, given the location of jellyfish in the water column and the information presented in the BA that indicates that any sediment plume associated with cable installation will be limited to the bottom 4 meters of the water column, we expect any exposure of jellyfish to TSS to be minimal. Based on this analysis, effects to leatherback sea turtles resulting from effects to their jellyfish prey are extremely unlikely to occur and thus discountable.

SAV/Eelgrass (Zostera marina)
In general, SAV provides important nursery and foraging habitat for ESA-listed sea turtles as well as for a number of potential prey species. As described in the COP and the EFH Assessment, there are no documented seagrass beds in the Atlantic Shores WDA. As such, no impacts to SAV are anticipated as a result of the proposed activities and thus no corresponding effects to ESA-listed sea turtles are anticipated...

7.3.4 Turbidity during WTG and OSS Foundation Installation

Pile driving for WTG and OSC-DC installation as well as the deposition of rock for gravel pads (gravity base foundations only), and deposition of scour protection at the base of these foundations may result in a minor and temporary increase in suspended sediment in the area immediately surrounding the foundation or scour protection being installed. The amount of sediment disturbed during these activities is minimal; thus, any associated increase in TSS will be small and significantly lower than the TSS associated with cable installation addressed above. Given the very small increase in TSS associated with foundation installation and placement of scour protection, any physiological or behavioral responses by ESA listed species from exposure to TSS are extremely unlikely to occur and thus discountable. Similarly, effects to listed species from any effects to prey would be too small to meaningfully measure, detect, or evaluate, and therefore, are insignificant.

7.3.5 Installation of Suction Bucket Foundations

To facilitate the installation of suction bucket foundations, a low-flow suction pump is installed at the top of each caisson (or "bucket"). During deployment, after the suction bucket has settled into the seafloor due to gravity, the suction pump will slowly remove water from within the bucket to create an area of reduced pressure against the seafloor, which will assist the suction bucket in completing penetration to the target depth. In the COP, Atlantic Shores indicates that the pump will operate at low enough rates so as not to disturb bottom sediments. As such, while there may be some minor suspension of sediment as the bucket settles into the sediment, no turbidity or suspended sediment is anticipated to result from the pumping operations. While specifics of the pump were not described in the BA and are not yet available, BOEM indicates that the pump will have screens with mesh size of approximately 0.841 mm (i.e., openings in the mesh are smaller than 1 mm). Combined with the anticipated low pump speed, we expect that this will make impingement or entrainment of any aquatic organisms, including small prey items such as copepods (2-5 mm), extremely unlikely to occur. The removed water will be released immediately outside the suction bucket. Effects to listed species due to disturbance of bottom sediments and pumping of water, inclusive of consideration of effects to prey, from installation of the suction bucket foundations are extremely unlikely to occur and thus discountable.

7.3.6 Lighting

In general, lights will be required on offshore platforms and structures, vessels, and construction equipment during construction. Construction activities could occur 24 hours a day to minimize the overall duration of activities and the associated period of potential impact on marine species. Although not anticipated, Atlantic Shores South expects that pile driving that was started during daylight could continue after dark or in low visibility conditions. Construction and support vessels would be required to display lights when operating at night and deck lights would be required to illuminate work areas. However, lights would be down shielded to illuminate the deck, and would not intentionally illuminate surrounding waters. If sea turtles, Atlantic sturgeon, whales, or their prey are attracted to the lights, it could increase the potential for interaction with equipment or associated turbidity. However, due to the nature of project activities and associated seafloor disturbance, turbidity, and noise, listed species and their prey are not likely to be attracted by lighting because they are disturbed by these other factors. As such, we have determined that any effects of project lighting on sea turtles, sturgeon, or whales are extremely unlikely to occur and thus discountable.

Lighting may also be required at on shore areas, such as where the cables will make landfall. Many of the onshore areas used for staging will be part of an industrial port where artificial lighting already exists. Sea turtle hatchlings are known to be attracted to lights and artificial beach lighting is known to disrupt proper orientation towards the sea. However, due to the distance from the nearest nesting beach to the project area (the straight-line distance through the Atlantic Ocean from Virginia Beach, VA, the northernmost area where successful nesting has occurred, and the WFA is over 300 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings and there will therefore be no effects to ESA-listed sea turtles.

7.4 Effects to Habitat and Environmental Conditions during Operation

Here, we consider the effects to listed species from alterations or disruptions to habitat and environmental conditions during the operations phase of the project. Specifically, we address electromagnetic fields and heat during cable operation, project lighting during operations, and the effects of project structures.

7.4.1 Electromagnetic Fields and Heat during Cable Operation

Electromagnetic fields (EMF) are generated by current flow passing through power cables during operation and can be divided into electric fields (called E-fields, measured in volts per meter, V/m) and magnetic fields (called B-fields, measured in µT) (Taormina et al. 2018). Buried cables reduce, but do not entirely eliminate, EMF (Taormina et al. 2018). When electric energy is transported, a certain amount is lost as heat by the Joule effect, leading to an increase in temperature at the cable surface and a subsequent warming of the sediments immediately surrounding the cable; for buried cables, thermal radiation can warm the surrounding sediment in direct contact with the cable, even at several tens of centimeters away from it (Taormina et al. 2018).

To minimize EMF generated by cables, all cabling would be contained in electrical shielding (i.e., bitumen impregnated hessian tape and polypropylene threads) to prevent detectable direct electric fields. Atlantic Shores South would also bury cables to a target burial depth of approximately 5 – 6 feet (1.5 – 2 meters) below the surface. The electrical shielding and burial are expected to control the intensity of EMF. However, magnetic field emissions cannot be reduced by shielding, although multiple-stranded cables can be designed so that the individual strands cancel out a portion of the fields emitted by the other strands. Normandeau et al. (2011) compiled data from a number of existing sources, including 19 undersea cable systems in the U.S., to characterize EMF associated with cables consistent with those proposed for wind farms. The dataset considers cables consistent with those proposed by Atlantic Shores South (i.e., up to 275 kV for HVAC or 525 kV for HVDC). In the paper, the authors present information indicating that the maximum anticipated magnetic field would be experienced directly above the cable (i.e., 0 m above the cable and 0 m lateral distance), with the strength of the magnetic field dissipating with distance. Based on this data, the maximum anticipated magnetic field would be 7.85 µT at the source, dissipating to 0.08 µT at a distance of 10 m above the source and 10 m lateral distance. By comparison, the Earth's geomagnetic field strength ranges from approximately 20 to 75 µT (Bochert and Zettler 2006) and the estimated EMF level in the Project area is 512 to 514 milligauss (mG; 50.5 microteslas [µT]) (NOAA 2022).

When electric energy is transported, a certain amount gets lost as heat, leading to an increased temperature of the cable surface and subsequent warming of the surrounding environment (OSPAR 2009). As described in Taormina et al. (2018), the only published field measurement study results are from the 166 MW Nysted wind energy project in the Baltic Sea (maximal production capacity of about 166 MW), in the proximity of two 33 and 132 kV AC cables buried approximately 1 m deep in a medium sand area. In situ monitoring showed a maximal temperature increase of about 2.5 ºC at 50 cm directly below the cable and did not exceed 1.4°C in 20 cm depth above the cable (Meißner et al., 2007). Taormina et al. caution that application of these results to other locations is difficult, considering the large number of factors affecting thermal radiation including cable voltage, sediment type, burial depth, and shielding. The authors note that the expected impacts of submarine cables would be a change in benthic community makeup with species that have higher temperature tolerances becoming more common. Taormina et al. conclude at the end of their review of available information on thermal effects of submarine cables that considering the narrowness of cable corridors and the expected weakness of thermal radiation, impacts are not considered to be significant. Based on the available information summarized here, and lacking any site-specific predictions of thermal radiation from the Atlantic Shores South Wind Farm inter-array cables and Atlantic Shores South export cables, we expect that any impacts will be limited to a change in species composition of the infaunal benthic invertebrates immediately surrounding the cable corridor. As such, we do not anticipate thermal radiation to change the abundance, distribution, or availability of potential prey for any species. As any increase in temperature will be limited to areas within the sediment around the cable where listed species do not occur, we do not anticipate any exposure of listed species to an increase in temperature associated with the cable.

Atlantic sturgeon
Sturgeons are electrosensitive and use electric signals to locate prey. Information on the impacts of magnetic fields on fish is limited. A number of fish species, including sturgeon, are suspected of being sensitive to such fields because they have magnetosensitive or electrosensitive tissues, have been observed to use electrical signals in seeking prey, or use the Earth's magnetic field for navigation during migration (EPRI 2013). Atlantic sturgeon have specialized electrosensory organs capable of detecting electrical fields on the order of 0.5 millivolts per meter (mV/m) (Normandeau et al. 2011). Exponent Engineering, P.C. (2018) calculated that the maximum induced electrical field strength from the Ocean Wind 1 Wind Farm inter-array cable and the Ocean Wind 1 export cable would be 0.43 mV/m or less, which is slightly below the detection threshold for Atlantic sturgeon. However, this analysis only considered EMF associated with buried cable segments. Based on relative magnetic field strength, the induced electrical field in cable segments that are covered by electrical armoring is expected to exceed the 0.5-mV/m threshold. This suggests that Atlantic sturgeon would be able to detect the induced electrical fields in immediate proximity to those cable segments. Similar information on the induced electrical field strength from the Atlantic Shores cables is not included in the BA, DEIS, or COP; however, given the similarities in the cables, burial depths, and location, it is reasonable to expect that the Atlantic Shores cables will be substantially similar to the Ocean Wind 1 cables.

Bevelhimer *et al*. 2013 examined the behavioral responses of Lake Sturgeon to electromagnetic fields. The authors also report on a number of studies, which examined magnetic fields associated with AC cables consistent with the characteristics of the cables proposed by Atlantic Shores South and report that in all cases magnetic field strengths are predicted to decrease to near-background levels at a distance of 10 m from the cable. Like Atlantic sturgeon, Lake Sturgeon are benthic oriented species that can utilize electroreceptor senses to locate prey; therefore, they are a reasonable surrogate for Atlantic sturgeon in this context. Bevelhimer et al. 2013 carried out lab experiments examining behavior of individual lake sturgeon while in tanks with a continuous exposure to an electromagnetic source mimicking an AC cable and examining behavior with intermittent exposure (i.e., turning the magnetic field on and off). Lake sturgeon consistently displayed altered swimming behavior when exposed to the variable magnetic field. By gradually decreasing the magnet strength, the authors were able to identify a threshold level (average strength ~ 1,000–2,000 μT) below which short-term responses disappeared. The anticipated maximum exposure of an Atlantic sturgeon to the proposed cable would range from 13.7 to 76.6 milligauss (mG) (1.37 to 7.66 μT) on the bed surface above the buried and exposed Atlantic Shores South cable, and 9.1 to 65.3 mG (.91 to 6.53 μT) above the buried and exposed inter-array cable, respectively. This is several orders of magnitude below the levels that elicited a behavioral response in the Bevelhimer et al. (2013) study. Induced field strength would decrease effectively to 0 mG within 25 feet of each cable (Exponent Engineering, P.C. 2018). By comparison, the earth's natural magnetic field is more than five times the maximum potential EMF effect from the Project. Background electrical fields in the action area are on the order of 1 to 10 mG from the natural field effects produced by waves and currents; this is several times higher than the EMF anticipated to result from the project's cables. As such, it is extremely unlikely that there will be any effects to Atlantic sturgeon due to exposure to the electromagnetic field from the proposed cable and these effects are therefore discountable.

ESA-Listed Whales

The current literature suggests that cetaceans can sense the Earth's geomagnetic field and use it to navigate during migrations but not for directional information (Normandeau et al. 2011). It is not clear whether they use the geomagnetic field solely or in addition to other regional cues. It is also not known which components of the geomagnetic field cetaceans are sensing (i.e. the horizontal or vertical component, field intensity or inclination angle). Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e. changes in magnetic field levels with distance) of 0.1 percent of the earth's magnetic field or about 0.05 microtesla (μT) (Kirschvink 1990). Assuming a 50-mG (5 μT) sensitivity threshold (Normandeau 2011), marine mammals could theoretically be able to detect EMF effects from the inter-array and Atlantic Shores South export cables, but only in close proximity to cable segments lying on the bed surface. Individual marine mammals would have to be within 3 feet or less of those cable segments to encounter EMF above the 50-mG detection threshold.

As described in Normandeau et al. (2011), there is no scientific evidence as to what the response to exposures to the detectable magnetic field would be. However, based on the evidence that magnetic fields have a role in navigation it is reasonable to expect that any effects would be related to migration and movement. Given the limited distance from the cable that the magnetic field will be detectable, the potential for effects is extremely limited. Even if listed whales did avoid the corridor along the cable route in which the magnetic field is detectable, the effects would be limited to minor deviations from normal movements. As such, any effects are likely to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Sea Turtles

Sea turtles are known to possess geomagnetic sensitivity (but not electro sensitivity) that is used for orientation, navigation, and migration. They use the Earth's magnetic fields for directional or compass-type information to maintain a heading in a particular direction and for positional or hemap-type information to assess a position relative to a specific geographical destination (Lohmann et al. 1997). Multiple studies have demonstrated magneto sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 μT for loggerhead turtles, and 29.3 to 200 μT for green turtles (Normandeau et al. 2011). While other species have not been studied, anatomical, life history, and behavioral similarities suggest that they could be responsive at similar threshold levels. For purposes of this analysis, we will assume that leatherback and Kemp's ridley sea turtles are as sensitive as loggerhead sea turtles.

Sea turtles are known to use multiple cues (both geomagnetic and nonmagnetic) for navigation and migration. However, conclusions about the effects of magnetic fields from power cables are still hypothetical, as it is not known how sea turtles detect or process fluctuations in the earth's magnetic field. In addition, some experiments have shown an ability to compensate for "miscues," so the absolute importance of the geomagnetic field is unclear.

Based on the demonstrated and assumed magneto sensitivity of sea turtle species that occur in the action area, we expect that loggerhead, leatherback, and Kemp's ridley sea turtles will be able to detect the magnetic field. As described in Normandeau et al. (2011), there is no scientific evidence as to what the response to exposures to the detectable magnetic field would be. However, based on the evidence that magnetic fields have a role in navigation it is reasonable to expect that effects would be related to migration and movement; however, the available information indicates that any such impact would be very limited in scope. As noted in Normandeau (2011), while a localized perturbation in the geomagnetic field caused by a power cable could alter the course of a turtle, it is likely that the maximum response would be some, probably minor, deviation from a direct route to their destination. Based on the available information, effects to sea turtles from the magnetic field associated with the Atlantic Shores South Wind Farm inter-array cable and Atlantic Shores South export cables are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, insignificant.

Effects to Prey

We have considered whether magnetic fields associated with the operation of the transmission line could impact benthic organisms that serve as sturgeon and sea turtle prey. Effects to forage fish, jellyfish, copepods, and krill are extremely unlikely to occur given the limited distance into the water column that any magnetic field associated with the transmission line is detectable. Information presented in the BA and COP (Vol II-I) summarizes a number of studies on the effects of exposure of benthic resources to magnetic fields. According to these studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Bochert and Zettler 2004, Normandeau *et al*. 2011). Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return to pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). Therefore, no impacts (short-term or long-term) of magnetic fields on prey for any listed species in the action area are expected and thus no corresponding effects to ESA-listed sea turtles and sturgeon are expected.

7.4.2 Lighting and Marking of Structures

To comply with FAA and USCG regulations, the WTGs and OSS will be marked with distinct lettering/numbering scheme and with lighting. The USCG requires that offshore wind lessees obtain permits for private aids to navigation (PATON, see 33 CFR part 67) for all structures located in or near navigable waters of the United States (see 33 CFR part 66) and on the OCS. PATON regulations require that individuals or organizations mark privately owned marine obstructions or other similar hazards. No additional buoys or markers will be installed in association with the PATON.

In general, lights will be required on offshore platforms and structures, vessels, and construction equipment during O&M and decommissioning of the Atlantic Shores South Wind Farm. O&M and support vessels would be required to display lights when operating at night and deck lights would be required to illuminate work areas. However, lights would be down shielded to illuminate the deck, and would not intentionally illuminate surrounding waters. If sea turtles, Atlantic sturgeon, whales, or their prey, are attracted to the lights, it could increase the potential for interaction with equipment or associated turbidity. However, due to the nature of project activities and associated seafloor disturbance, turbidity, and noise, listed species and their prey are not likely to be attracted by lighting because they are disturbed by these other factors. As such, we have determined that any effects of project lighting on sea turtles, sturgeon, or whales are extremely unlikely and thus discountable.

In addition to vessel lighting, the WTGs will be lit for navigational and aeronautical safety. Lighting may also be required at on shore areas, such as where the cables will make landfall. Many of the onshore areas used for staging will be part of an industrial port where artificial lighting already exists. Sea turtle hatchlings are known to be attracted to lights and artificial beach lighting is known to disrupt proper orientation towards the sea. However, due to the distance from the nearest nesting beach to the project area (the straight-line distance through the Atlantic Ocean from Virginia Beach, VA, the northernmost area where successful nesting has occurred, and the WFA is approximately 300 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings.

7.4.3 WTG and OSS Foundations

The physical presence of structures in the water column has the potential to disrupt the movement of listed species but also serve as an attractant for prey resources and subsequently listed species. Structures may also provide habitat for some marine species, creating a reef effect. The foundations and generation of wind energy may affect the in-water and in-air conditions, which can result in changes to ecological conditions in the marine environment. Here, we consider the best available data that is currently available to address the potential effects on ESA listed species from the Atlantic Shores South project.

7.4.3.1 Consideration of the Physical Presence of Structures on Movements of Listed Species

The only wind turbines currently in operation in U.S. waters are the five WTGs that make up the Block Island Wind Farm and the two WTGs that are part of the Coastal Virginia Offshore Wind pilot project. We have not identified any reports or publications that have examined or documented any changes in listed species distribution or abundance at the Block Island or Virginia wind projects and have no information to indicate that the presence of these WTGs has resulted in any change in distribution of any ESA listed species.

As explained in section 6 of this Opinion, the WFA is used by Atlantic sturgeon for migration and potentially for opportunistic foraging. Consistent with information from other coastal areas that are not aggregation areas, we expect individual Atlantic sturgeon to be present in the WFA for short periods of time (<2 days; Ingram et al. 2019, Rothermal et al. 2020). Because Atlantic sturgeon carry out portions of their life history in rivers, they are frequently exposed to structures in the water such as bridge piers and pilings. There is ample evidence demonstrating that sturgeon routinely swim around and past large and small structures in waterways, often placed significantly closer together than even the minimum distance of the closest WTGs (see e.g., AKRF 2012). As such, we do not anticipate that the presence of the WTGs or the OSS will affect the distribution of Atlantic sturgeon in the action area or their ability to move through the action area.

Given their distribution largely in the open ocean, whales and sea turtles may rarely encounter large fixed structures in the water column such as the turbine foundations; thus, there is little information to evaluate the effects that these structures will have on the use of the area by these species. Sea turtles are often sighted around oil and gas platforms and fishing piers in the Gulf of Mexico which demonstrates they do not have an aversion to structures and may utilize them to forage or rest (Lohoefener 1990, Rudloe and Rudloe 2005). Given the monopiles' large size (15 m diameter) and presence above and below water, we expect that whales and sea turtles will be able to visually detect the structures and, as a result, we do not expect whales or sea turtles to collide with the stationary foundations. Listed whales are the largest species that may encounter the foundations in the water column. Of the listed whales, blue whales are the largest species at up to 90 ft. Based on the spacing of the foundations (0.6 x 0.6 nm grid) relative to the sizes of the listed species that may be present in the WFA, we do not anticipate that the foundations would create a barrier or restrict the ability of any listed species to move through the area freely.

While there is currently no before/after data for any of the ESA listed species that occur in the action area in the context of wind farm development, data is available for monitoring of harbor porpoises before, during, and after construction of three offshore wind projects in Europe. We consider that data here.

Horns Rev 1 in the North Sea consists of 80 WTGs laid out as an oblique rectangle of 5 km x 3.8 km (8 horizontal and 10 vertical rows). The distance between turbines is 560 m in both directions. The project was installed in 2002 (Tougaard et al. 2006). The turbines used at the Horns Rev 1 project are older geared WTGs and not more modern direct-drive turbines, which are quieter (Elliot et al. 2019; Tougaard et al. 2020). The Horns Rev 1 project has a similar number of foundations to the Ocean Wind 1 project (80 foundations) but turbine spacing is significantly closer together (0.5 km compared to at least 1.8 km). Pre-construction baseline data was collected with acoustic recorders and with ship surveys beginning in 1999; post-construction acoustic and ship surveys continued until the spring of 2006. In total, there were seven years of visual/ship surveys and five years of acoustic data. Both sets of data indicate a weak negative effect on harbor porpoise abundance and activity during construction, which has been tied to localized avoidance behavior during pile driving, and no effects on activity or abundance linked to the operating wind farm (Tougaard et al. 2006).

Teilmann et al. (2007) reports on continuous acoustic harbor porpoise monitoring at the Nysted wind project (Baltic Sea) before, during, and after construction. The results show that echolocation activity significantly declined inside Nysted Offshore Wind Farm since the pre-construction baseline during and immediately after construction. Teilmann and Carstensen (2012) update the dataset to indicate that echolocation activity continued to increase as time went by after operations began. Thompson et al. (2010) reported similar results for the Beatrice Demonstrator Project, where localized (1-2 km) responses of harbor porpoises were found through PAM, but no long term changes were found. Scheidat et al. (2011) reported results of acoustic monitoring of harbor porpoise activity for one year prior to construction and for two years during operation of the Dutch offshore wind farm Egmond aan Zee. The results show an overall increase in acoustic activity from baseline to operation, which the authors note is in line with a general increase in porpoise abundance in Dutch waters over that period. The authors also note that acoustic activity was significantly higher inside the wind farm than in the reference areas, indicating that the occurrence of porpoises in the wind farm area increased during the operational period, possibly due to an increase in abundance of prey in this area or as refuge from heavy vessel traffic outside of the wind farm area. Teilmann and Carstensen (2012) discuss the results of these three studies and are not able to determine why harbor porpoises reacted differently to the Nysted project. One suggestion is that as the area where the Nysted facility occurs is not particularly important to harbor porpoises, animals may be less tolerant of disturbance associated with the operations of the wind farm. It is important to note that the only ESA listed species that may occur within the WFA that uses echolocation is the sperm whale. Baleen whales, which includes North Atlantic right whales, fin, blue, and sei whales, do not echolocate. Sperm whales use echolocation primarily for foraging and social communication (NMFS 2010, NMFS 2015, Miller et al. 2004, Watwood et al. 2006); sperm whales are expected to be rare in the WFA due to the shallow depths and more typical distribution near the continental shelf break and further offshore. Sperm whale foraging is expected to be limited in the lease area because sperm whale prey occurs in deeper offshore waters (500-1,000m) (NMFS 2010). Therefore, even if there was a potential for the presence of the WTGs or foundations to affect echolocation, it is extremely unlikely that this would have any effect on sperm whales given their rarity in the WFA. Consideration of the effects of operational noise on whale communication is presented in section 7.1 of this Opinion.

Absent any information on the effects of wind farms or other foundational structures on the local abundance or distribution of whales and sea turtles, it is difficult to predict how listed whales and sea turtles will respond to the presence of the foundations in the water column. However, considering just the physical structures themselves, given the spacing between the turbines we do not expect that the physical presence of the foundations alone will affect the distribution of whales or sea turtles in the action area or affect how these animals move through the area. Additionally, the available data on harbor porpoises supports the conclusion that if there are decreases in abundance during wind farm construction those are not sustained during the operational period. As explained in section 7.1, we have determined that effects of operational noise will be insignificant and are not likely to disturb or displace whales, sea turtles, or Atlantic sturgeon. In the sections below, we consider the potential for the reef effect to affect species distribution in the WFA and the potential for the foundations and WTGs to affect habitat conditions and prey that could influence the abundance and distribution of listed species in the WFA.

7.4.3.2 Habitat Conversion and Reef Effect Due to the Presence of Physical Structures

As described in the BA, long-term habitat alteration would result from the installation of the foundations, scour protection around the WTG and OSS foundations, as well as cable protection along any portions of the inter-array and export cables that could not be buried to depth. Scour protection would extend up to 269 feet (82 meters) from the base of each WTG foundation and be placed to a depth of up to 8.2 feet (2.5 meters), depending on the chosen design. Placement of scour protection for WTG foundations would result in the modification of up to 261 acres of seabed. For the OSSs, scour protection would extend up to 695.5 feet from the base of each foundation and be placed to a depth of up to 8.2 feet, depending on the chosen design, resulting in the modification of up to 26 acres of seabed. Cable protection for the export cables would result in conversion of 345 acres of soft-bottom habitat to hard-bottom habitat. In total, the Proposed Action would result in the conversion of up to 632 acres of soft-bottom habitat. The addition of the project foundations, is expected to result in a habitat shift in the area immediately surrounding each foundation from soft sediment, open water habitat system to a structure-oriented system, including an increase in fouling organisms. .

Table X. Habitat Conversion (acres) Associated with the Minimum and Maximum Footprint for each Construction Scenario (differences are dependent on number of each type of foundations)

Project Component	Scenario 1		Scenario 2	
	Minimum Impact	Maximum Impact	Minimum Impact	Maximum Impact
WTG foundations with scour protection	261	261	203	222
OSS foundations with scour protection	7	26	7	26
Cable protection	345	345	345	345
Total	613	632	555	593

Source: Atlantic Shores South BA, July 2023

Over time (weeks to months), the areas with scour protection are likely to be colonized by sessile or mobile organisms (e.g., sponges, hydroids, crustaceans). This results in a modification of the benthic community in these areas from primarily infaunal organisms (e.g., amphipods, polychaetes, bivalves). Hard-bottom and vertical structures in a soft-bottom habitat can create artificial reefs, thus inducing the ‘reef’ effect (Taormina et al. 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans in the area immediately surrounding the new structure (Taormina et al. 2018). This could provide a potential increase in available forage items for sea turtles compared to the surrounding soft-bottoms; however, this change in distribution/aggregation of some species does not necessarily increase overall biomass. In the North Sea, Coolen et al. (2018) sampled epifouling organisms at offshore oil and gas platforms and compared data to samples from the Princess Amalia Wind Farm (PAWF) and natural rocky reef areas. The 60 PAWF monopile turbine foundations with rock scour protection were deployed between November 2006 and March 2007 and surveys were carried out in October 2011 and July 2013. This study demonstrated that the WTG foundations and rocky scour protection acted as artificial reef with a rich abundance and diversity of epibenthic species, comparable to that of a natural rocky reef.

Stenburg et al. (2015) studied the long-term effects of the Horns Rev 1 offshore wind farm (North Sea) on fish abundance, diversity, and spatial distribution. Gillnet surveys were conducted in September 2001, before the WTGs were installed, and again in September 2009, 7 years post-construction at the wind farm site and at a control site 6 km away. The three most abundant species in the surveys were whiting (*Merlangius merlangus*), dab (*Limanda limanda*), and sand lance (*Ammodytidae spp*.). Overall fish abundance increased slightly in the area where the wind farm was established but declined in the control area 6 km away. None of the key fish species or functional fish groups showed signs of negative long-term effects due to the wind farm. Whiting and the fish group associated with rocky habitats showed different distributions relative to the distance to the artificial reef structures introduced by the turbines. Rocky habitat fishes were most abundant close to the turbines while whiting was most abundant away from them. The authors also note that the wind farm development did not appear to affect the sand-dwelling species dab and sand lance, suggesting that the direct loss of habitat (<1% of the area around the wind farm) and indirect effects (e.g. sediment composition) were too low to influence their abundance. Species diversity was significantly higher close to the turbines. The authors conclude that the results indicate that the WTG foundations were large enough to attract fish species with a preference for rocky habitats, but not large enough to have adverse negative effects on species inhabiting the original sand bottom between the turbines. However, more research is still needed within offshore wind farm areas because each offshore wind farm area contains different environmental characteristics. For instance, research from Daewel et al. (2022) suggest changes in organic sediment distribution and quantity could have an effect on the habitat quality for benthic species such as Ammodytes spp. (e.g., sand lance) that live in the sediments within wind farm areas.

Methratta and Dardick (2019) carried out a meta-analysis of studies in Europe to examine finfish abundance inside wind farms compared to nearby reference sites. The overall effect size was positive and significantly different from zero, indicating greater abundance of fish inside of wind farm areas compared to the reference sites. More specifically, the study determined increases were experienced for species associated with both soft-bottom and complex-bottom habitat but changes in abundance for pelagic species were not significantly different from zero. The authors report that no significant negative effects on abundance were identified.

Hutchison et al. (2020) describes benthic monitoring that took place within the Block Island Wind Farm (BIWF, Rhode Island) to assess spatiotemporal changes in sediment grain size, organic enrichment, and macrofauna, as well as the colonization of the jacket foundation structures, up to four years post-installation. The greatest benthic modifications occurred within the footprint of the foundation structures through the development of mussel aggregations. Additionally, based on the presence of juvenile crabs (Cancer sp.),the authors conclude that the BIWF potentially serves as a nursery ground, as suggested from increased production rates for crabs (*Cancer pagurus*) at European OWFs (Krone et al., 2017). The dominant mussel community created three-dimensional habitat complexity on an otherwise smooth structure, benefiting small reef species such as cunner (*Tautogolabrus adspersus*), while at a larger scale, the turbine structures hosted abundant black sea bass (*Centropristis striata*) and other indigenous bentho-pelagic fish.

For the Atlantic Shore South project, effects to listed species from the loss of soft bottom habitat and conversion of soft bottom habitat to hard bottom habitat may occur if this habitat shift resulted in changes in use of the area (considered below) by listed species or resulted in changes in the availability, abundance, or distribution of forage species.

The only forage fish species we expect to be impacted by the loss of soft-bottom habitat would be sand lance (*Ammodytes spp.).* The ESA listed species in the WDA that may forage on sand lance include Atlantic sturgeon, fin, and sei whales. As sand lance are strongly associated with sandy substrate, and the project would result in a loss of such soft bottom, there would be a reduction in availability of habitat for sand lance that theoretically could result in a localized reduction in the abundance of sand lance in the action area. However, even just considering the WFA, which is dominated by sandy substrate, the loss or conversion of soft bottom habitat is very small, approximately 0.6% (and an even smaller percentage of the action area). The results from Stenburg et al. (2015; summarized above) suggest that this loss of habitat is not great enough to impact abundance in the area and that there may be an increase in abundance of sand lance despite this small loss of habitat. However, even in a worst case scenario assuming that the reduction in the abundance of sand lance is directly proportional to the amount of soft substrate lost, we would expect a 0.6% reduction in availability of sand lance in the lease area and an even smaller reduction in the sand lance available as forage for fin and sei whales and Atlantic sturgeon in the action area. Given this small, localized reduction in sand lance and that sand lance are only one of many species the fin and sei whales and Atlantic sturgeon may feed on in the action area, any effects to these species are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant.

Based on the available information (e.g., Methratta and Dardick 2019, Stenburg et al. 2015), we expect that there may be an increase in abundance of schooling fish in the WFA that sei or fin whales may prey on but that this increase may be a result of redistribution of species to the WFA rather than a true increase in abundance. Either way, at the scale of the action area, the effects of any increase in abundance of schooling fish resulting from the reef effect will be so small that the effects to sei or fin whales cannot be meaningfully measured, evaluated, or detected and thus are insignificant. Similarly, we expect that there may be an increase in jellyfish and other gelatinous organism prey of leatherback sea turtles but that at the scale of the action area, any effects to leatherback sea turtles will be so small that they cannot be meaningfully measured, evaluated, or detected and thus insignificant. Because we expect sperm whale foraging to be limited in the WFA (due to the shallow depths and location inshore of the shelf break), any effects to sperm whale foraging as a result of localized changes in the abundance or distribution of potential prey items are extremely unlikely and thus discountable.

Atlantic sturgeon would experience a reduction in infaunal benthic organisms, such as polychaete worms, in areas where soft substrate is lost or converted to hard substrate. As explained above, the action area is not an aggregation area or otherwise known to be a high use area for foraging. Any foraging by Atlantic sturgeon is expected to be limited to opportunistic occurrences. Similar to the anticipated reduction in sand lance, the conversion of soft substrate to hard substrate may result in a proportional reduction in infaunal benthic organisms that could serve as forage for Atlantic sturgeon. Assuming that the reduction in the abundance of infaunal benthic organisms in the action area is directly proportional to the amount of soft substrate lost, we would expect an extremely small (0.6% of the lease area and an even smaller percentage of the total action area) reduction in the abundance of these species as forage for Atlantic sturgeon in the action area. Given that any reduction in potential prey items for Atlantic sturgeon will be small, localized, and patchy and that the WDA is not an area that sturgeon are expected to be dependent on for foraging, any effects to Atlantic sturgeon are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant. Also, to the extent that epifaunal species richness is increased in the WFA due to the reef effect of the WTGs and their scour protection, and to the extent that sturgeon may feed on some of these benthic invertebrates, any negative effects may be offset.

The available information suggests that the prey base for Kemp's ridley and loggerhead sea turtles may increase in the action area due to the reef effect of the WTGs, associated scour protection, and an increase in crustaceans and other forage species. However, given the small size of the area impacted and any potential resulting increase in available forage, any effects of this patchy and localized increase in abundance are likely to be so small that they cannot be meaningfully measured, evaluated, or detected and are thus insignificant. No effects to the forage base of green sea turtles are anticipated as no effects on marine vegetation are anticipated.

No effects to copepods that serve as the primary prey for right whales are anticipated to result from the reef effect considered here. In section 7.4.3.3 below, we explain how the physical presence of the foundations may affect ecological conditions that could impact the distribution, abundance, or availability of copepods.

7.4.3.3 Effects to Oceanic and Atmospheric Conditions due to Presence of Structures and Operation of WTGs

As explained in section 6.0 (*Environmental Baseline*), the Atlantic Shores South WFA is located within multiple defined marine areas. Here, we consider the best available information on how the presence and operation of 200 WTGs, 10 OSSs, and 1 Met Tower from the proposed Atlantic Shores South Wind Farm project may affect the oceanographic and atmospheric conditions in the action area and whether there will be any consequences to listed species.

A number of theoretical, model-based, and observational studies have been conducted to help inform the potential effects offshore wind farms may have on the oceanic and atmospheric environment; summaries of several of these studies are described in this section. In 2022, NMFS contracted with EA Engineering to prepare a literature review on this topic. Much of the information in this section of the Opinion is based on that review. In general, most of these studies discuss local scale effects (within the area of the windfarm) and are focused in Europe where commercial-scale offshore wind farms are already in operation. At various scales, documented effects include increased turbulence, changes in sedimentation, reduced water flow, and changes in hydrodynamics, wind fields, stratification, water temperature, nutrient upwelling, and primary productivity.

Two turbines were installed offshore Virginia in the summer of 2020 where the weather and hydrodynamic conditions were measured during the installation period; however, no additional reports or literature about oceanographic or atmospheric impacts during operation has been published (HDR 2020). Similarly, no reports or literature about oceanographic or atmospheric impacts during operation of the five turbines at the Block Island Wind Farm have been published. As described in the Environmental Baseline section, offshore construction for the Vineyard Wind 1 and South Fork Wind projects, both located north of the Atlantic Shores South

WFA, began in the summer of 2023; as neither of these projects is operational yet, there are not yet any available studies about the effects of either project on oceanographic or atmospheric conditions.

Background Information on Oceanic and Atmospheric Conditions in the Project Area
The broadest area, the U.S. Northeast Shelf Large Marine Ecosystem, extends from the Gulf of Maine to Cape Hatteras, North Carolina (Kaplan 2011). The WDA is located within the Southern Mid-Atlantic Bight sub-region of the Northeast U.S. Shelf Ecosystem, which is distinct from other regions based on differences in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). The physical oceanography of this region is influenced by the seafloor, freshwater input from multiple rivers and estuaries, large-scale weather patterns, and tropical or winter coastal storm events. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011). These dynamic regional ocean properties support a diverse and productive ecosystem that undergoes variability across multiple time scales.

A variety of existing oceanographic research and monitoring is conducted in the region by state and federal agencies, academic institutions, and non-governmental organizations using an array of platforms including ships, autonomous vehicles, buoys, moorings, and satellites. Research and monitoring efforts include measuring the physical and biological structure of the ocean environment including variables such as temperature, chlorophyll, and salinity at a range of depths as well as long-term shelf-wide surveys that provide data used to estimate spawning stock biomass, overall fish biodiversity, zooplankton abundance, information on the timing and location of spawning events, and insight to detect changes in the environment. In the waters of the WFA and further south and east along the continental shelf, the broad, year-round pattern of currents are generally understood. Shelf currents in the Atlantic Shores South project area generally flow in a southerly direction (WHOI 2016). These bottom currents are influenced by local bathymetry and regional density gradients. Prominent bottom features of the Mid-Atlantic Bight include a series of ridges and troughs. On the OCS off the coast of New Jersey, the largest slopes are associated with sand ridges, which are generally parallel to the shoreline and are actively modified by ocean currents (Goff et al 2005). While the WFA is a generally flat expanse of soft sediments with seafloor slopes that are typically less than 1°, geophysical surveys in and near portions of the lease area identified ridges of up to 15m (49 ft.) above the surrounding seabed (Guida et al 2017, Ocean Wind 2022). From the coastline to the WFA along the export cable routes, there is a shallow slope with an average gradient of less than 1°.

On a seasonal scale, the greater Mid-Atlantic Bight region experiences one of the largest transitions in stratification in the entire Atlantic Ocean (Castelao, Glenn, and Schofield, 2010). Starting in the late spring, a strong thermocline develops at approximately 20 m depth across the middle to outer shelf, and forms a thermally isolated body of water known as the "cold pool" which shifts annually but generally extends from the waters of southern New England (in some years, the WFA is on the northern edge of the cold pool) to Cape Hatteras. Starting in the fall, the cold pool breaks down and transitions to cold and well-mixed conditions that last through the winter (Houghton et al. 1982). The cold pool is particularly important to a number of demersal and pelagic fish and shellfish species in the region, but also influences regional biological oceanography as wind-assisted transport and stratification have been documented to be important components of plankton transport in the region (Checkley et al. 1988, Cowen at al. 1993, Hare et al. 1996, Grothues et al. 2002, Sullivan et al. 2006, Narvaez et al. 2015, Munroe et al. 2016).

The region also experiences upwelling in the summer driven by southwest winds associated with the Bermuda High (Glenn & Schofield 2003; Glenn et al. 2004). Cold nutrient-rich water from the cold pool can be transported by upwelling events to surface and nearshore waters. At the surface, this cold water can form large phytoplankton blooms, which support many higher trophic species (Sha et al. 2015).

The cold pool supports prey species for ESA-listed species, both directly through providing habitat and indirectly through its influence on regional biological oceanography, which supports a productive ecosystem (Kane 2005, Chen et al. 2018, Winton et al. 2018). Lower-trophic plankton species are well adapted to take advantage of the variable seasonality of the regional ecosystem, and support the upper food web for species such as pelagic fish, sea turtles, and marine mammals (Kenney and Vigness-Raposa 2010, Pershing and Stamieszkin 2019). Though plankton exhibit movement behavior, physical and oceanographic features (e.g. tidal mixing fronts, thermal fronts, freshwater plumes, internal waves, stratification, horizontal and vertical currents, and bathymetry) are the primary drivers that control aggregations and concentrate them by orders of magnitude (Pershing and Stamieszkin 2019, Kraus et al. 2019).

Many marine species including fish, sea turtles, and marine mammals forage around these physical and oceanographic features where prey is concentrated. Physical and oceanographic features are the primary drivers that control aggregations and concentrations of plankton. ESA-listed species in the region primarily feed on five prey resources - zooplankton, pelagic fish, gelatinous organisms, marine vegetation, and benthic mollusks. Of the listed species in the area, North Atlantic right whales are the only obligate zooplanktivores (i.e., they eat only zooplankton). Sei and fin whales may be present in the WFA, however in addition to plankton both species eat small schooling fish.

As described in the Environmental Baseline, North Atlantic right whales have been observed in or near New Jersey waters during all four seasons; however, they are most common in spring when they are migrating north and in fall during their southbound migration (Geo-Marine 2010, Kenney and Vigness-Raposa 2010, Roberts et al. 2016, Roberts et al. 2020). These seasonal occurrence observations are aligned with more recent findings from aerial survey data collected from 2017-2020, where North Atlantic right whales were seen in waters adjacent to New York during all seasons except summer (Zoidis et al. 2021). Additionally, buoys and gliders have detected North Atlantic right whale calls in the vicinity of the Atlantic Shores lease area (WHOI 2021). A single North Atlantic right whale sighting occurred in the Study Corridor during Ocean Wind's Geotechnical 1A Survey in winter 2017-2018 (Smultea Environmental Sciences 2018), but no North Atlantic right whales were observed during the Ocean Wind Offshore Wind Farm Survey in summer 2017 in the Study Corridor (Alpine 2017); the Ocean Wind survey area is adjacent to the Atlantic Shores lease area. Three North Atlantic right whale sightings within the Ocean Wind survey area were reported between 13 and 14 December 2018 (NOAA Right Whale Sighting and Advisory System 2019). No right whales were observed during eight days of aerial surveys of the Atlantic Shores lease area between October 15, 2020 and May 7, 2021 (Atlantic Shores COP Appendix II-L2).

Whitt et al. (2013) reported behaviors for two juvenile right whales that were sighted together including skim-feeding behavior offshore of Barnegat Bay. Although feeding could not be confirmed by prey samples or evidence of prey patches, the authors surmise that the nearshore waters of New Jersey may be utilized as more than just a migratory pathway; and that feeding may occur outside of the typical feeding period of spring through early fall and in areas farther south than the main feeding grounds (Winn et al. 1986, Gaskin 1987, 1991, Hamilton and Mayo 1990, Kenney et al. 1995, Whitt et al 2013). The May 2019 sighting of a single North Atlantic right whale skim feeding at the shelf break in adjacent New York Bight waters, supplement and update what is currently known about the distribution and habitat use patterns of North Atlantic right whales in the larger Mid-Atlantic Bight.

Based on the best available scientific information, North Atlantic right whales may opportunistically forage in the Atlantic Shores South WDA when suitably dense patches of prey are present. However, this is not a primary foraging area, an area where individuals are expected to be resident, and it is not known or expected to routinely support sustained foraging behavior.

Effects on Water Temperature

A modeling study was conducted for the Great Lakes region of the U.S. to simulate the impact of 432 9.5 MW (4.1 GW total) offshore wind turbines on Lake Erie’s dynamic and thermal structure. Model results showed that the wind farms did have an impact on the area they were built in by reducing wind speed and wind stress, which led to less mixing, lower current speeds and higher surface water temperature (Afsharian et al. 2020). The model demonstrated reduced wind speed and stress leading to less mixing, lower current speeds, and higher surface water temperatures (1-2.8°C, depending on the month). No changes to temperatures below the surface are reported. The authors note that these impacts were limited to the vicinity of the wind farm. Though modeled in a lake environment, these results may be informative for predicting effects in the marine environment as the presence of structures and interactions with wind and water may act similarly; however, given the scale of the model and specificity of the modeled conditions and outputs to Lake Erie it is not possible to directly apply the results to an offshore wind project in the action area generally or the Atlantic Shores South project in particular.

Some literature is available that considers the potential impacts of wind power development on temperature. Miller and Keith (2018) developed a model to better understand climatic impacts due to wind power extraction; however, the paper addresses how a modeled condition would affect average surface temperatures over the continental U.S. and does not address offshore wind turbines or any effects on ocean water temperatures. Wang and Prinn (2010 and 2011) carried out modeling to simulate the potential climatic effects of onshore and offshore wind power installations; they found that while models of large scale onshore wind projects resulted in localized increases in surface temperature (consistent with the pattern observed in the Miller and Keith paper), the opposite was true for models of offshore wind projects. The authors found a local cooling effect, of up to 1°C, from similarly sized offshore wind installations. The authors provide an explanation for why onshore and offshore turbines would result in different localized effects.

Golbazi et al. 2022 simulated the potential changes to near-surface atmospheric properties caused by large offshore wind farms equipped with offshore wind turbines of 10 and 15 MW. In the model, they simulated 30 GW of offshore wind turbines located in identified lease and planning areas in the U.S. Atlantic. The model results show that, at hub height, an average wind speed deficit of 0.5 m/s extends up to 50 km downwind from the edge of the farms with an average wind speed reduction at the surface that is 0.5 m s/1 or less (a 10% maximum reduction) within the project footprint. This results in a slight cooling, up to −0.06 K, at the surface in the summer. The authors conclude that, on average, meteorological changes at the surface induced by 10-15 MW offshore wind turbines will be nearly imperceptible in the summer. They also note that future research is needed to explore changes in other seasons.

If the effects predicted by the model in Golbazi et al. and Wang and Prinn are realized as a result of the Ocean Wind 1 project, minor cooling of waters in the action area in the summer months would be expected. We do not anticipate that any minor cooling of waters in the action area in the summer months would have any effects to the abundance or distribution of listed species or the abundance or distribution of prey. Based on the available information, any effects to listed species from any changes in water temperature (if there are any at all) will be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant.

Ocean-Atmosphere and Wind Field Interactions

Studies have examined the wind wakes produced by turbines and the subsequent turbulence and reductions in wind speed, both in the atmosphere and at the ocean surface. In general, as an air current moves towards and past a turbine, the structure reduces air velocities (reduced kinetic energy in the atmosphere) downstream and has the potential to generate turbulence near the ocean surface. This relative velocity deficit and increased turbulence near turbine structures create a cone-shaped wake of wind change (known as wind wake) in the downstream region from the turbine. Wind wakes vary in size and magnitude and vary based on natural environmental conditions (i.e. wind speed, direction) and turbine size and layout. Studies elucidating the relationship between offshore wind facilities and the atmospheric boundary layer, meteorology, downstream areas, and the interface with the ocean are still emerging. No in-situ studies have been carried out in the U.S. to date. Alterations to wind fields and the ocean–atmosphere interface have the potential to modify both atmospheric and hydrodynamic patterns, potentially on large spatial scales up to dozens of miles (~20+ km) from the offshore wind facility (Dorrell et al. 2022, Gill et al. 2020, Christiansen et al. 2022). Interactions between the ocean and the atmosphere in the presence of wind turbine structures are highly variable based on ambient wind speed, the degree of atmospheric stability, and the number of turbines in operation.

Generally, a wind energy facility is expected to reduce average wind speeds both upstream and downstream; however, studies report a wide range of values for average wind speed deficits, in terms of both magnitude and spatial extent. Wind wake propagation generally extends longer in stable atmospheric conditions where there is less influence from vertical mixing (Christiansen et al. 2022, Golbazi et al. 2022). Upstream of a large, simulated offshore wind facility, Fitch et al. (2012) found wind blocking effects to reduce average wind speeds by 1% as far as 9 miles (15 km) ahead of the facility. Downstream of an offshore wind facility, wind speeds may be reduced up to 46%, with wind wakes ranging from 3 to 43 miles (5 to 70 km) from the turbine or array

(Christiansen and Hasager 2005; Carpenter et al. 2016; Platis et al. 2018; Cañadillas et al. 2020; van Berkel et al. 2020; Floeter et al. 2022). Wind speed deficit is greatest at hub height downstream of the facility, with the deficit decreasing closer to the ocean surface (Golbazi et al. 2022). However, while models and observations indicate that the maximum wind speed deficit occurs at hub height inside the wind wake downstream of an offshore wind energy facility, reduction in average wind speeds near the ocean surface has also been modeled and observed (Christiansen et al. 2022). Simulations of multiple clustered, large offshore wind facilities in the North Sea suggest that wind wake may extend as far as 62 miles (100 km) (Siedersleben et al. 2018). On the U.S. northeast shelf, wind wakes emerging from simulations of full lease area buildouts with 15 megawatt WTGs (150 m hub height) were shown to combine and extend as far as 93 miles (150 km) on certain days (Golbazi et al. 2022). Wind speed reduction may occur in an area up to 100 times larger than the offshore wind facility itself (van Berkel et al. 2020). A recent study has investigated long-range wind wake deficit potential in the New York Bight offshore development area using weather research and forecasting (WRF) offshore wind facility parameterization. ArcVera Renewables (2022) determined that expert literature that used engineering wake loss models has under-predicted wind wakes, and their study describes wind wakes that extend up to or greater than 62 miles (100 km) downstream of large offshore wind facilities.

Reductions in surface winds and wind stress have been modeled to be observed over tens of kilometers downwind from turbine arrays and may be influenced by closely adjacent wind farms (Christiansen et al. 2022). A study on the effect of large offshore wind farms (~ 80 turbines) in Europe on the local wind climate using satellite synthetic aperture radar found that a decrease of the mean wind speed is found as the wind flows through the wind farms, leaving a velocity deficit of 8–9% on average, immediately downstream of the wind turbine arrays. Wind speed was found to recover to within 2% of the free stream velocity over a distance of 5–20 km past the wind farm, depending on the ambient wind speed, the atmospheric stability, and the number of turbines in operation (Christiansen & Hasager 2005). Christiansen et al. (2022) found that simulated wind wakes varied individually in size and intensity due to the different sizes of North Sea facilities and due to superposition of neighboring wakes, with the strongest wind speed deficits modeled in densely built areas. Using an aircraft to measure wind speeds around turbines, Platis et al. (2018) found a reduction in wind speed within 10km of the turbine.

Ocean-Atmosphere Responses to Wind Field Interactions

The disturbance of wind speed and wind wakes from wind farms can cause oceanic responses such as upwelling, downwelling, and desertification (van Berkel et al. 2020; Dorrell et al. 2022; Floeter et al. 2022). According to Broström (2008), a windfarm can cause a divergence/convergence in the upper ocean due to a strong horizontal shear in the wind stress and resulting curl of the wind stress. This divergence and convergence of wind wakes can cause upwelling and downwelling. Upwelling can have significant impacts on local ecosystems due to the influx of nutrient rich, cold, deep, water that increases biological productivity and forms the basis of the lower trophic level. Broström 2008 indicates that the induced upwelling by a wind farm will likely increase primary production, which may affect the local ecosystem. Oceanic response to an altered wind field is predicted to extend several kilometers around offshore wind facilities and to be strong enough to influence the local pelagic ecosystem (Broström 2008; Ludewig 2015; Floeter et al. 2022). Floeter et al. (2022) conducted the first observations of wind wake-induced upwelling/downwelling dipoles and vertical mixing downstream of offshore wind facilities in the North Sea. The study identified two characteristic hydrographic signatures of wind wake-induced dipoles. First, distinct changes in mixed layer depth and water column potential energy anomaly were observed over more than 3 miles (5 kilometers). Second, the thermocline exhibited diagonal excursions, with maximum vertical displacement of 46 feet (14 meters) over a dipole dimension of 6–7 miles (10–12 kilometers). Additionally, preliminary research by Daewel et al. (2022) suggests that ongoing offshore wind energy developments can have a significant impact on coastal marine ecosystems. This study deduced that wind wakes of large offshore wind energy clusters in the North Sea cause large-scale changes in annual primary production with local changes of up to 10%. These changes occur within the immediate vicinity of the offshore wind energy cluster and travel over a wider region (up to 1–2 kilometers outside the cluster of projects).

Wave amplitude within and surrounding offshore wind energy facilities may be altered by changes to the wind field. A decrease in surface roughness can be observed in optical and radar images at considerable distances down-wind of a wind farm under certain conditions (Forster 2018). Johnson et al. (2021b) analyzed localized turbulence effects of various proposed offshore wind build-out scenarios using a three-dimensional model from Cape Hatteras to offshore Cape Cod, with a finer mesh embedded in the Massachusetts/Rhode Island wind energy area. Results of the hydrodynamic modeling suggested that the extraction of wind energy by offshore wind facilities in the Massachusetts/Rhode Island wind energy area could reduce current magnitude and wave height. By modifying the sea surface wind shear stress, wind energy extraction affected the wind field within and beyond the modeled facility (comprising a full build-out of the wind energy area with 1,063 turbines, each 12-MW). Relative to the modeled baseline, significant wave height was reduced by up to 2.46 feet (0.75 meter) inside the facility, by up to 1.48 feet (0.45 meter), just outside the facility, and up to 0.49 foot (0.15 meter) at the coast.

The regional impact of wind wakes is challenging to quantify due to natural spatiotemporal variability of wind fields, sea levels, and local ocean surface currents in the northeast shelf (Floeter et al. 2022). Individual dipole patterns can either superimpose or decrease airflow velocities, for example depending on the spatial orientation of the tidal ellipse in relation to the direction of the wind wake (Floeter et al. 2022). Wind farms may also create a damming effect where a regional high pressure zone is created upwind of the turbines and air deflects up and over the turbine causing a low pressure zone in the middle. This air mass returns to the surface downstream of the turbine field, creating a dipole local high/low pressure zone on the ocean surface which can affect local currents including upwelling and downwelling (Christiansen et al. 2022). Increased airflow velocities near the water surface result in decreased water surface elevation of a 2-millimeter magnitude, while decreased airflow velocities result in increased water surface elevation of a similar magnitude (Christiansen et al. 2022). This magnitude may be negligible in the context of the substantial year-to-year changes in annually averaged coastal sea level in the northeast shelf (i.e., 650 millimeters), which is attributed to the region's existing along-shelf wind stress (Andres et al. 2013; Li et al. 2014). Christiansen et al. (2022) modeled sea surface velocity changes downstream of multiple offshore arrays in the North Sea and found that induced changes equated to a "substantial" 10–25% of the interannual and decadal sea surface velocity variability in the region.

Hydrodynamic Interactions

The introduction of offshore wind energy facilities into ocean waters influences adjacent ocean flow characteristics, as turbine foundation structures and currents, tides, etc. interact. The dynamics of ocean flow past vertical structures has received relatively more study in well-mixed seas than in strongly stratified seas (Dorrell et al. 2022). Most studies on wake and turbulence caused by foundation structures are gleaned from modeled simulations, as field studies are challenging due to the numerous variables and natural variability in flow (Schultze et al. 2020). Only two studies to date have observed in situ the response of stratified waters to the presence of offshore wind energy facilities (Floeter et al. 2017; Schultze et al. 2020).

Hydrodynamic effects of offshore wind facilities and their secondary effects are only beginning to be studied within United States shelf waters. Johnson et al. (2021) prepared a hydrodynamic modeling study investigating the potential impacts of offshore wind energy development on oceanographic conditions in the northeast shelf, assessing the changes in hydrodynamic conditions resulting from a theoretical modeled offshore wind facility in the Massachusetts-Rhode Island offshore wind energy area. The results suggest that introduction of 1,063 12 MW WTGs would influence the thermal stratification by introducing additional mixing. The model suggests a relative deepening in the thermocline compared to baseline temperatures of approximately 3.3 to 6.6 feet (1 to 2 meters) and retention of colder water within the footprint of the modeled wind facility through the summer months (Johnson et al. 2021). The study also suggested that the thermocline would on average move deeper in both the spring and summer models, with more cold water retained within the footprint of the offshore wind facility (Johnson et al. 2021b). The results of Johnson et al. (2021) contrast with a European field study by Floeter et al. (2017) in the German North Sea, which found a doming of the thermocline and enhanced mixing, or more uniform temperatures, in the layer below the thermocline. While the Floeter et al. (2017) study observed changes in vertical mixing, and enhanced local upwelling, these changes may be due to natural variability. Additionally, there are numerous differences between the sites in Southern New England and the German North Sea. First, the climate setting and hydrodynamic conditions differ (e.g., offshore wind facility locations relative to the shelf, general circulation around the offshore wind facilities, temperature and stratification regime, depth, and solar radiation and heat transfer). Second, the operational status of the actual and modeled offshore wind facilities differs (i.e., there being no current speed reduction due to wind wake loss in the German North Sea study) (Johnson et al. 2021). Additionally, while Johnson et al. (2021) conclude that the introduction of the offshore wind energy structures modifies temperature stratification by introducing additional mixing, the model did not include influences from strong storms, which are a primary component of mixing in the Southern New England region. The authors acknowledge that the model's single year of simulations would require additional years to assess year-to-year variability of the model parameters and that modeling of this nature is more suited for a review of differences between scenarios rather than absolute accuracy of individual scenarios.

Using remote sensing, Vanhellemont and Ruddick (2014), showed that offshore wind farms can have impacts on suspended sediments. Wakes of turbidity from individual foundations were observed to be in the same direction as tidal currents, extending 30–150 m wide, and several km in length. However, the authors indicate the environmental impact of these wakes and the source of the suspended material were unknown. Potential effects could include decreased underwater light field, sediment transport, and downstream sedimentation (Vanhellemont and Ruddick 2014).

The primary structure-induced hydrodynamic effects of wind turbine foundations are friction and blocking, which increase turbulence, eddies, sediment erosion, and turbidity in the water column (van Berkel et al. 2020). A number of studies have investigated the impacts of offshore wind farms on stratification and turbulence (Carpenter et al. 2016, Dorrell et al. 2022; Schultz et al. 2020). As water moves past wind turbine foundations the foundations generate a turbulent wake that will contribute to a mixing of a stratified water column or may disperse aggregations of plankton. These studies have demonstrated decreased flow and increased turbulence extending hundreds of meters from turbine foundations. However, the magnitude is highly dependent on the local conditions (e.g. current speed, tides, and wind speed), with faster flow causing greater turbulence and extending farther from the foundation. Carpenter et al. (2016) used a combination of numerical models and in situ measurements from two windfarms (Bard 1 and Global Tech 1) to conduct an analysis of the impact of increased mixing in the water column due to the presence of offshore wind structures on the seasonal stratification of the North Sea. Based on the model results and field measurements, estimates of the time scale for how long a complete mixing of the stratification takes was found to be longer, though comparable to, the summer stratification period in the North Sea. The authors concluded that it is unlikely the two windfarms would alter seasonal stratification dynamics in the region. The estimates of mixing were found to be influenced by the pycnocline thickness and drag of the foundations of the wind turbines. For there to be a significant impact on stratification from the hydrodynamic impacts of turbine foundations over a large area, large regions (length of 100 km) of the North Sea would need to be covered with wind farms; however the actual threshold was not defined (Carpenter et al. 2016). Schultz et al. 2020 found similar results in the same area of the German Bight of the North Sea.

Monopiles were found to increase localized vertical mixing due to the turbulence from the wakes generated from monopiles, which in turn could decrease localized seasonal stratification and could affect nutrient cycling on a local basis. Using both observational and modeling methods to study impacts of turbines on turbulence, Schultze et al. (2020) found through modeling simulations that turbulent effects remained within the first 100 m of the turbine foundation under a range of stratified conditions. Field measurements at the OWF DanTysk in the German Bight of the southern North Sea, observed a wake area 70 m wide and 300 m long from a single monopile foundation during weak stratification (0.5°C surface-to bottom temperature difference). No wake or turbulence was detected in stronger thermal stratification (~3°C surface-to-bottom temperature difference) (Schultze et al. 2020). The OWF DanTysk is composed of 6 m diameter monopiles. Similarly, a laboratory study measured peak turbulence within 1 monopile diameter distance from the foundation and that downstream effects (greater than 5% of background) persisted for 8–10 monopile diameters distances from the foundation (Miles, Martin, and Goddard 2017).

Impacts on stratification and turbulence could lead to changes in the structure, productivity, and circulation of the oceanic regions; however, the scale and degree of those effects is dependent in part on location. If wind farms are constructed in areas of tidal fronts, the physical structure of wind turbine foundations may alter the structure of fronts, which could affect distribution of prey and lead to effects to the marine vertebrates that use these oceanic structures for foraging (Cazenave et al. 2016). As areas of frontal activity are often pelagic biodiversity hotspots, altering their structure may decrease efficient foraging opportunities for listed species. In an empirical bio-physical study, Floeter et al. (2017) used a remotely operated vehicle to record conductivity, temperature, depth, oxygen, and chlorophyll-a measurements of an offshore wind farm. Vertical mixing was found to be increased within the wind farm, leading to a doming of the thermocline and a subsequent transport of nutrients into the surface mixed layer. Though discerning a wind farm-induced relationship from natural variability is difficult, wind farms may cause enhanced mixing, and due to the interaction between turbulence levels and the growth of phytoplankton, this could have cascading effects on nutrient levels, ecosystems, and marine vertebrates (Carpenter et al. 2016, Floeter et al. 2017). Water flowing around turbine foundations may also cause eddies to spawn, potentially resulting in more retention of plankton in the region when combined daily vertical migration of the plankton (Chen et al. 2016, Nagel et al. 2018). However, it is important to note that these conclusions from Chen et al. (2016) are hypothesized based on a modeling study and not observed in the region.

Van Berkel et al (2020) investigated available information on the effects of offshore wind farms on hydrodynamics and implications for fish. The authors report that changes in the demersal community have been observed close to wind farms (within 50 m) and that those changes are related to structure-based communities at the wind farm foundations (e.g., mussels). The authors also report on long-term studies of fish species at the Horns Reef project (North Sea) and state that no significant changes in abundance or distribution patterns of pelagic and demersal fish have been documented between control sites and wind farm sites or inside/between the foundations at wind farm sites. They report that any observed changes in density were consistent with changes in the general trend of species reflected in larger scale stock assessment reports (see also Stenberg et al. 2015).

Modeling experiments have demonstrated that the introduction of monopiles could have an impact on the M2 amplitude (semidiurnal tidal component due to the moon) and phase duration. Modeling showed the amplitude increased between 0.5-7% depending on the preexisting amphidrome, defined as the geographical location, which has zero tidal amplitude for one harmonic constituent of the tide. Changes in the tidal amplitude may increase the chances of coastal flooding in low-lying areas. However, we have no information to suggest that any potential effects on M2 amplitude would have any effects on marine resources generally or ESA-listed species specifically.

Primary Production and Plankton Distribution

The influence of altered atmospheric and hydrodynamic turbulence on the vertical mixing of the water column may impact the delivery of nutrients to the euphotic zone, the upper layer of the water column that receives sufficient light penetration for photosynthesis, and which generally occurs within the upper 100–170 ft. (30–52 m) of the water column in the northeast shelf (Ma and Smith 2022). Seasonal mixing of the water column provides nutrients to support phytoplankton growth, with primary production at deeper depths being limited by lack of sunlight (Dorrell et al. 2022). As water flows around turbine and OSS foundations there is the potential that aggregations of planktonic prey may be dispersed due to the increased mixing caused by water moving around foundations; however, it is also possible that foundations will act to trap prey if eddies form in the wake of turbine foundations or concentrate prey in a convergent current situation. However, decreased mixing could also cause increased stratification and subsequently affect the exchange of nutrients, heat, and trap prey. Modeling studies in the Southern New England region have found changes in distribution patterns of planktonic larvae under offshore wind build-out scenarios (Johnson et al. 2021, Chen et al. 2021), suggesting similar impacts could occur with right whale's zooplankton prey.

A few studies have been conducted to evaluate how altered hydrodynamic patterns around offshore wind projects could affect primary production as well as upper trophic levels. Floeter et al., 2017 demonstrated with empirical data from the southern North Sea that increased vertical mixing at an offshore wind farm resulted in the transport of nutrients to the surface mixed layer and subsequent uptake by phytoplankton in the photic zone. Increased primary production could increase the productivity of bivalves and other macrobenthic suspension feeders that are expected to be a major component of artificial reef communities that form on turbine foundations (Slavik et al., 2019, Mavraki et al., 2020; Daewel et al. 2022). The results of analyses conducted by Floeter et al. 2017 and Friedland et al. 2021 suggest that wind farm effects on phytoplankton and zooplankton might extend to upper trophic level impacts, potentially modifying the distribution and abundance of finfish and invertebrates. However, the spatial scale of these effects could range from localized within individual farms to broader spatial scales (Carpenter et al., 2016; Bakhoday-Paskyabi et al., 2018).

Wang et al. 2018 evaluated pre and post-construction water column properties (water temperature, dissolved oxygen, and suspended matter concentration) and zooplankton community structure at an offshore wind farm in China. The wind farm consisted of 70 WTGS (232 MW total) located in the intertidal zone less than 11 km from the shore in the Yellow Sea. The goal of this study was to examine the responses of the zooplankton community to the establishment of an OWF, the causes of any observed effects, and their relation to environmental factors in the study area. The analysis documented changes in the zooplankton community (e.g., seasonal increases and decreases in macro- and micro-zooplankton). However, given that there are significant differences in the location and conditions between the site in China and the Ocean Wind location (e.g., tidal flat/intertidal zone vs. well offshore) and the layout of the site (WTGs are much closer together at the China site) it is not clear that the results of this study will be informative for the Atlantic Shores South Wind project.

Daewel et al. 2022 used modeling to demonstrate the effects of wind wake from offshore wind projects in the North Sea on primary productivity. The model results show that the systematic modifications of stratification and currents alter the spatial pattern of ecosystem productivity; annual net primary production (netPP) changes in response to OWF wind wake effects in the southern North Sea show both areas with a decrease and areas with an increase in netPP of up to 10%. There was a decrease in netPP in the center of the large OWF clusters in the inner German Bight and at Dogger Bank, which are both situated in highly productive frontal areas, and an increase in areas around these clusters in the shallow, near-coastal areas of the German Bight and at Dogger Bank. The authors note that additional work is needed to identify the robustness of these patterns with respect to different weather conditions and interannual variations. They also note that when integrated over a larger area, the estimated positive and negative changes tend to even out. Besides the changes in the pelagic ecosystem, the model results highlight a substantial impact on sedimentation and seabed processes. The overall, large-scale reduction in average current velocities results in reduced bottom-shear stress to up to 10% locally; however, averaged over larger areas the effect is less pronounced with only a 0.2% increase North Sea wide. The model also indicates an impact of OWF on bottom water oxygen in the southern North Sea. In an area with a bathymetric depression (Oyster Grounds), the dissolved oxygen concentrations in late summer and autumn were further reduced by about 0.3 mg l^{-1} on average and up to 0.68 mg l^{-1} locally. In other areas of the southern North Sea, the effect was estimated to be less severe, or even showing an increase in dissolved oxygen concentration, along the edges of Dogger Bank for example.

Consideration of Potential Effects of the Atlantic Shores South Wind Farm

In general, the studies referenced above describe varying scales of impacts on the oceanographic and atmospheric processes as a resultant effect of offshore wind turbine development. These impacts include increased turbulence generated by the presence of turbine foundations, extraction of wind by turbine operations reducing surface wind stress and altering water column turbulence, and upwelling and downwelling caused by the divergence and convergence of wind wakes (Miles et al. 2021). Oceanographic and atmospheric effects are possible at a range of temporal and spatial scales, based on regional and local oceanographic and atmospheric conditions as well as the size and locations of wind farms. However, discerning a wind farm-induced relationship from natural variability is difficult and very specific to local environmental conditions where the wind farm is located. As described above, the particular effects and magnitudes can vary based on a number of parameters, including model assumptions and inputs, study site, oceanographic and atmospheric conditions, turbine size, and wind farm size and orientation (Miles et al. 2021). Here, we consider the information presented above, incorporate the layout and parameters of the Atlantic Shores South Wind Farm and local oceanographic and atmospheric conditions and evaluate effects to ESA-listed species. We note that while we are using the best available information to assess effects of the Atlantic Shores South project, there is significant uncertainty about how offshore wind farms in the action area may alter oceanographic processes and the biological systems that rely on them. The available information suggests that some impacts require very large scale wind development before they would be realized; as such, we note that the conclusions reached here are specific to the scope of the Atlantic Shores South project (200 WTGs and their foundations, up to 10 OSSs and their foundations, and 1 Met Tower, total approximate capacity of 2,800 MW) and may not be reflective of the consequences of larger scale development in the region or even a single project in a different location.

As explained above, based on the available information, we do not see any evidence that installation of 200 WTGs and their foundations and up to 10 OSSs and their foundations and 1 Met Tower for the Atlantic Shores South project would lead to ocean warming that could affect ESA-listed whales, sea turtles or fish or that there is the potential for the Atlantic Shores South project to contribute to or exacerbate warming ocean conditions; if anything, the project may result in minor, localized cooling. The available information suggests that the Atlantic Shores South project will produce wind wake from operation of the turbines and that the foundations themselves will lead to disruptions in local conditions. The scale of these effects is expected to range in distance, with effects to turbulence, eddies, and turbidity extending around a hundred meters (van Berkel et al. 2020) and changes in mixed layer depth and thermocline conditions extending up to 12 km (Floeter et al. 2022), while alterations to wind fields and the ocean–

atmosphere interface have the potential to modify both atmospheric and hydrodynamic patterns, potentially on large spatial scales up to dozens of miles (Gill et al. 2020; Christiansen et al. 2022). As noted above, oceanic response to an altered wind field is predicted to extend several kilometers around offshore wind facilities and to be strong enough to influence the local pelagic ecosystem (Brostrom 2008, Ludewig 2015, Floeter et al. 2022).

When applying studies conducted outside the Mid-Atlantic Bight region to our consideration of the potential effects of the Atlantic Shores South project on environmental conditions, it should be noted that the seasonal stratification over the summer, particularly in the studies conducted in the North Sea, is much less than the peak stratification seen in the summer over the Mid-Atlantic Bight. The conditions in the North Sea are more representative of weaker stratification, similar to conditions seen in the Mid-Atlantic Bight during the spring or fall. Because of the weaker stratification during the spring and fall, the Mid-Atlantic Bight ecosystem may be more susceptible to changes in hydrodynamics due to the presence of structures during the spring and fall than during highly stratified conditions in the summer.

Offshore wind energy development has the potential to alter the atmospheric and the physical and biological oceanographic environment due to the influence of the wind turbines on the wind stress at the ocean surface and the physical presence of the in-water turbine foundations could influence the flow and mixing of water. Resultant, increased stratification could affect the timing and rate of breakdown of the cold pool in the fall, which could have cascading effects on species in the region. However, as described above, the available information (Carpenter et al. 2016, Schultz et al. 2020) indicates that in order to see significant impacts on stratification, large regions had to be covered by wind turbines. Given the scale of the Atlantic Shores project, any effects of stratification are not expected to reach the scale that they would affect the timing and rate of breakdown of the cold pool in the fall.

Due to the linkages between oceanography and food webs, lower-tropic level prey species that support protected species may be affected by changes in stratification and vertical mixing. Information on which to base an assessment of the degree that the proposed project will result in any such impacts is limited. No utility scale offshore wind farms exist in the region nor along either coast of the United States to evaluate potential impacts of the proposed Project, thus we primarily have results from research conducted on offshore wind projects in other countries available to evaluate potential impacts on the oceanographic and atmospheric environment, and potential subsequent effects on protected species and their prey.

Results of in-situ research, and modeling and simulation studies, show that offshore wind farms can reduce wind speed and wind stress which can lead to less mixing, lower current speeds, and higher surface water temperature (Afsharian et al. 2020); increase localized vertical mixing due to the turbulence from the wakes produced from water flowing around turbine foundations (Miles, Martin, and Goddard 2017, Schultz et al. 2020); cause wind wakes that will result in detectable changes in vertical motion and/or structure in the water column (upwelling and downwelling) (Christiansen & Hasager 2005, Broström 2008); and result in detectable sediment wakes downstream from a wind farm by increased turbidity (Vanhellemont and Ruddick, 2014). We have considered if these factors could result in disruption of prey aggregations, primarily of planktonic organisms transported by currents such as copepods and gelatinous organisms (salps, ctenophores, and jellyfish medusa).

This possible effect is primarily relevant to North Atlantic right whales and leatherback sea turtles as their planktonic prey (calanoid copepods and gelatinous organisms) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for listed species to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities for listed species. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species which eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents. Prey aggregations may also be influenced by the physical presence of turbine foundations and subsequent reef effect; this is considered in Section 7.4.3.2.

Relative to the Mid-Atlantic Bight as a whole, the scale of the proposed Project (no more than 211 foundations a) and the footprint of the WFA (102,136-acres, 413.3km^2) with project foundations occupying only a small fraction of that) is small. Based on the available information, we do not expect the scope of hydrodynamic effects to be large enough to influence regional conditions that could affect the distribution of prey, mainly plankton, or conditions that aggregate prey in the local area off the coast of New Jersey or broader Mid-Atlantic Bight. However, we do expect localized impacts to oceanic conditions that would extend 5-12 km from the border of the lease area.

Although uncertainty remains as to the magnitude and intensity of effects offshore wind farms may have on altering oceanographic processes, studies demonstrate increased turbulence may occur in the wake of turbine (and OSS) foundations. These turbulence wakes have been detected up to 300 m from the turbine foundation (Miles, Martin, and Goddard 2017, Schultz et al. 2020). Peak turbulence area is expected within the distance equivalent to the diameter of a single monopole, with turbulence measurable (greater than 5% above background) within a distance equivalent to 8-10 times the diameter of a single monopole (Miles, Martin and Goddard 2017), for the Atlantic Shores South project that would be a distance of 120 to 150 m. We would expect that any effects on the distribution of prey due to turbulence from the foundation would be limited to the area where changes in turbulence would be experienced. These anticipated localized changes at the WFA and waters down-current of the foundations of the wind turbines could result in localized changes in plankton distribution and abundance. Given the available information, we expect these changes to be limited to the area within approximately 1 km of any single foundation (Floeter et al. 2017). Based on the spacing of the turbines (1.1 km x 1.1 km), the available information suggests limited opportunity for these areas to interact and overlap which may limit the impact of the distribution of plankton to largely the WFA and up to 1.1 km around its border. Based on the available information, we do not expect the changes from the Atlantic Shores South project to affect the oceanographic forces transporting zooplankton into the area; therefore, while there may be changes in the distribution of plankton within the WFA, we do not expect any overall reduction in biomass of plankton. Thus, because we do not anticipate any change in the biomass of zooplankton, we do not anticipate any higher trophic level impacts; that is, we do not anticipate any associated effects to gelatinous organisms, pelagic fish, or benthic invertebrates that depend on plankton as forage.

Right whales are the only ESA-listed obligate zooplanktivores in the project area, feeding exclusively on copepods, which are primarily aggregated by physical and oceanographic features. While we do not expect the Atlantic Shores South WTGs and the foundations to affect the abundance of copepods in the WFA area or any broader area, the distribution of copepods in the WFA footprint may be affected; however, given the limited foraging by right whales in the WFA and surrounding area that may be affected by changes in ecological conditions, any limited impacts on the distribution of copepods would have effects on right whales that are so small that they cannot be meaningfully measured, evaluated, or detected and thus insignificant. Similarly, we do not expect any changes in the abundance of leatherback sea turtle's jellyfish prey, and anticipate that any changes in distribution of jellyfish would have effects on leatherbacks that are so small that they cannot be meaningfully measured, evaluated, or detected and thus insignificant. We do not anticipate a larger disruption to conditions that would aggregate prey in the lease area due to the small scale of the project and the distance from frontal features.

Given the localized and patchy effects anticipated to the distribution and aggregation of prey, and that we do not expect any overall reduction in the amount of prey in the action area, any effects to foraging individual right whales or leatherback sea turtles are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. Additionally, as Atlantic sturgeon in the marine environment primarily feed on benthic invertebrates and small fish such as sand lance, which are either free swimming or live on the seafloor, hydrodynamic effects are not likely to impact the distribution or availability of their prey, and any effects to Atlantic sturgeon are extremely unlikely to occur and are thus discountable. Effects to the benthic prey base of green, Kemp's ridley, and loggerhead sea turtles are also extremely unlikely to occur and are thus discountable. We do not expect any impacts to the abundance or distribution of the cephalopods on which sperm whales forage. As a result, any effects to sperm whales are extremely unlikely to occur and are thus discountable.

We note that as the scale of offshore wind development in the Mid-Atlantic Bight increases and the area occupied by wind turbines increases, the scope and scale of potential hydrodynamic impacts may also increase and influence the environmental baselines for future projects. Such impacts may require additional research and analysis to support future assessments. Biological Opinions prepared for the Vineyard Wind 1, South Fork Wind, Ocean Wind 1, Revolution Wind, Empire Wind, and Sunrise Projects (i.e., the commercial scale wind projects in the action area) assessed the construction, operation, and decommissioning of each project and concluded that there may be localized changes in the respective lease areas and surrounding waters within a few hundred meters to tens of kilometers down-current/downwind of the foundations and WTGs, with effects on zooplankton prey limited to the area within a few hundred meters of each foundation. The Ocean Wind 1 project that will consist of up to 98 WTGs is located directly adjacent to the south from the proposed Atlantic Shores South project. Even considering the anticipated effects to the Atlantic Shores South project in light of the 98 WTGs of the adjacent Ocean Wind 1 project, any effects to ESA listed species from the Atlantic Shores South project would be so small that they cannot be meaningfully measured, evaluated, or detected.

Offshore wind development to the north of the Atlantic Shores South project in the Mid-Atlantic Bight region and in southern New England waters is underway. The Empire Wind project which is located in the Mid-Atlantic Bight region is approximately 130 km to the north of the Atlantic Shores South project. The Revolution Wind project located in southern New England is approximately 330 km to the north of the Atlantic Shores South project. The Coastal Virginia Offshore Wind Commercial (CVOW-C) project is approximately 274 km to the south of the Atlantic Shores South project. Once built we expect that all of these projects will be too far away for oceanographic, hydrodynamics, or atmospheric effects to impact Atlantic Shores South WFA. Therefore, while in the future there may be addictive effects resulting from the buildout of multiple adjacent lease areas, the conclusions reached in this analysis do not change when considering the effects in the context of the *Environmental Baseline*.

7.5 Effects of Marine Resource Survey and Monitoring Activities

Atlantic Shores will carry out survey and monitoring activities in and near the WDA. As described in Section 3.0 of this Opinion, these will include: otter trawl, ventless trap, and hydraulic clam dredge surveys to characterize fisheries resources in the WDA; benthic monitoring to document the disturbance and recovery of marine benthic habitat and communities resulting from the construction and installation of Atlantic Shores South project components in the WDA and along the offshore export cable corridors; and deployment of PAM buoys or autonomous PAM devices to record ambient noise and characterize the presence of protected species, specifically marine mammals and cod vocalizations. In this section, we consider the effects of the marine resource survey and monitoring activities on listed species in the action area by describing the effects of interactions between listed species, and proposed survey gear and the other sampling and monitoring methodologies, and then analyze risk and determine likely effects to sea turtles, listed whales, and Atlantic sturgeon. Section 7.1 of the Opinion addresses the effects of noise during surveys, including HRG surveys; as noted there, the operating frequencies of the SSS and MBES equipment proposed for use in the benthic monitoring mean that no effects to ESA listed species will occur even if individuals are exposed to the noise from that equipment. Effects of Project vessel operations (e.g. increased vessel transit and traffic), including the operations related to vessels that will be used for survey and monitoring activities, are considered in Section 7.2, above, and are not repeated here.

7.5.1 Assessment of Effects of Benthic Monitoring, Acoustic Telemetry Monitoring, PAM, and SAV Monitoring

Benthic Sampling
Atlantic Shores is proposing to conduct benthic monitoring to document the disturbance and recovery of marine benthic habitat and communities resulting from the construction and installation of Project components. Monitoring will be conducted using a combination of grab sampling and remotely operated vehicle (ROV) imaging techniques. Grab sampling would occur once per year in the year prior to construction activities, within the first year after Project completion, in the third year after Project completion, and potentially in the fifth year after Project completion, with 378 grabs collected during each annual sampling event. All survey equipment will be deployed from contracted scientific research vessels. SPI/PV will be used to characterize existing conditions and changes in soft-bottom benthic habitat prior to and following

construction. The SPI/PV equipment consists of a camera frame that is lowered onto the seabed by a cable, penetrating the bed surface to collect a plan view image of subsurface substrate composition. Following construction, high-resolution imaging collected by ROV will be used to monitor changes in benthic community composition on introduced hard surfaces (i.e., WTG/OSS foundations, scour protection layers, and cable protection layers). Underwater imagery would be collected in the same years that benthic grab sampling occurs.

The ROV video, grab sampling, and SPI/PV surveys will result in temporary disturbance of the benthos and temporary loss of benthic resources in the disturbed areas. The survey equipment will affect an extremely small area at each survey location (~1.5 m^2). Any loss of benthic resources will be small, temporary, and localized to the areas disturbed by survey activities; recolonization is expected to be rapid. These temporary, isolated reductions in the amount of benthic resources are not likely to have a measurable effect on any foraging activity or any other behavior of listed species; this is due to the small size of the affected areas and the temporary nature of any disturbance. As effects to listed species that may forage on these benthic resources (i.e., Atlantic sturgeon and some sea turtles) will be so small that they cannot be meaningfully measured, detected, or evaluated, effects are insignificant.

Passive Acoustic Monitoring

PAM is used to measure, monitor, record, and determine the sources of sound in underwater environments. Moored PAM systems or autonomous PAM devices will be used prior to, during, and following construction. PAM will be used to characterize the presence of marine mammals and cod through passive detection of vocalizations, and will be used to record ambient noise, project vessel noise, pile driving noise, and WTG operational noise. Moored PAM systems are stationary and may include platforms that reside completely underwater with no surface expression (i.e., HARPs, high-frequency acoustic recording packages) or may consist of buoys (at the surface) connected via a data and power cable to an anchor or bottom lander on the seafloor. Moored PAM systems will use the best available technology to reduce any potential risks of entanglement and deployment will comply with best management practices designed to reduce the risk of entanglement in anchored monitoring gear (see Appendix B of NMFS 2021a as appended to this Opinion). For moored PAM systems, there are cables connecting the hydrophones and/or buoy to the anchor or lander; however, entanglement is extremely unlikely to occur. The cables associated with moored systems have a minimum bend radius that minimizes entanglement risks and does not create loops during deployments, further minimizing entanglement risks. There are no records of any entanglement of listed species in moored PAM systems, and we do not anticipate any such entanglement will occur.

Mobile systems may include autonomous PAM devices that may operate at the surface or operate throughout the water column. These vehicles produce virtually no self-generated noise and travel at slow operational speeds (∼0.25 m/s) as they collect data. Moored and mobile systems will be deployed and retrieved by vessels; maintenance will also be carried out from vessels. Potential effects of vessel traffic for all activities considered in this consultation are addressed in Section 7.2. The small size and slow operational speeds of mobile PAM systems make the risk of a collision between the system and a listed species extremely unlikely to occur. Even in the extremely unlikely event that a whale, sea turtle, or Atlantic sturgeon bumped into the mobile PAM system, it is extremely unlikely that there would be any consequences to the individual because of the relative lightweight of the mobile PAM system, slow operating speeds, small size, and rounded shape.

Based on the analysis herein, it is extremely unlikely that any ESA listed species will interact with any PAM system; any effects to ESA listed species of the PAM monitoring are extremely unlikely to occur and are therefore, discountable.

Other Buoy Deployments

BOEM has indicated that one or more data collection buoys may be deployed in the WDA to provide weather and other data in the project area. Best management practices for moored buoys used for data collection associated with offshore wind projects are described in the June 29, 2021 informal programmatic consultation between NMFS/GARFO and BOEM on certain geophysical and geotechnical survey activities and data collection buoy deployment (see Appendix C of this Opinion). The minimization measures in Appendix C are incorporated as elements of the proposed action for this opinion. BOEM has indicated that any data collection buoys deployed as part of the Atlantic Shores South project will be consistent with the best management practices and project design criteria included in the June 2021 consultation. Therefore, consistent with the conclusions of the 2021 programmatic, we expect any effects to ESA listed species to be extremely unlikely to occur and therefore, discountable.

7.5.2 Assessment of Risk of Interactions with Otter Trawl Gear

Atlantic Shores will conduct five years of otter trawl surveys (up to 2 years pre/during construction and 3 years post-construction) to assess the finfish community in the northern portion of the Atlantic Shores South WFA and two adjacent control areas. As described in Section 3.0, the surveys will be adapted to Northeast Area Monitoring and Assessment Program (NEAMAP) protocols. Approximately 108 tows will be conducted each year (27 tows each season) across the Atlantic Shores South WFA and two stratified control areas within 5.6 km from the outermost row of turbine foundations, during daylight hours (after sunrise and before sunset) for 20 minutes each with a target tow speed of 2.9 to 3.3 knots. All survey activity will take place within the action area.

ESA Listed Whales

Factors Affecting Interactions and Existing Information on Interactions

Entanglement or capture of ESA listed North Atlantic right, fin, sei and sperm whales in beam or bottom otter trawl gear is extremely unlikely. While these species may occur in the study area where survey activities will take place, otter trawl gear is not expected to directly affect right, fin, sei and sperm whales given that these large cetaceans have the speed and maneuverability to get out of the way of oncoming gear, which is towed behind a slow moving vessel (less than 4 knots). There have been no observed or reported interactions of right, fin, sei or sperm whales with otter trawl gear (NEFSC observer/sea sampling database, unpublished data; GAR Marine Animal Incident database, unpublished data). The slow speed of the trawl gear being towed and the short tow times to be implemented further reduce the potential for entanglement or any other interaction. As a result, we have determined that it is extremely unlikely that any large whale would interact with the trawl survey gear.

Effects to Prey
The proposed bottom trawl survey activities will not have any effects on the availability of prey for right, fin, sei, and sperm whales. Right whales and sei whales feed on copepods (Perry et al. 1999). Copepods are very small organisms that will pass through trawl gear rather than being captured in it. In addition, copepods will not be affected by turbidity created by the gear moving through the water. Fin whales feed on krill and small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002). The trawl gear to be used in the Atlantic Shores survey activities operates on or very near the bottom, while schooling fish such as herring and mackerel occur higher in the water column. Sand lance inhabit both benthic and pelagic habitats, however, they typically bury into the benthos and would not be caught in the trawl. Sperm whales feed on deep-water species that do not occur in the area to be surveyed.

Sea Turtles

Factors Affecting Interactions and Existing Information on Interactions
Sea turtles forcibly submerged in any type of restrictive gear can eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage and Lutz 1997; Lutcavage et al. 1997). A study examining the relationship between tow time and sea turtle mortality in the shrimp trawl fishery showed that mortality was strongly dependent on trawling duration, with the proportion of dead or comatose sea turtles rising from 0% for the first 50 minutes of capture to 70% after 90 minutes of capture (Henwood and Stuntz 1987). Following the recommendations of the NRC to reexamine the association between tow times and sea turtle deaths, the data set used by Henwood and Stuntz (1987) was updated and re-analyzed (Epperly et al. 2002; Sasso and Epperly 2006). Seasonal differences in the likelihood of mortality for sea turtles caught in trawl gear were apparent. For example, the observed mortality exceeded 1% after 10 minutes of towing in the winter (defined in Sasso and Epperly (2006) as the months of December-February), while the observed mortality did not exceed 1% until after 50 minutes in the summer (defined as March-November; Sasso and Epperly 2006). In general, tows of short duration (<10 minutes) in either season have little effect on the likelihood of mortality for sea turtles caught in the trawl gear and would likely achieve a negligible mortality rate (defined by the NRC as <1%). Longer tow times (up to 200 minutes in summer and up to 150 minutes in winter) result in a rapid escalation of mortality, and eventually reach a plateau of high mortality, but will not equal 100%, as a sea turtle caught within the last hour of a long tow will likely survive (Epperly et al. 2002; Sasso and Epperly 2006). However, in both seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006) as had been found by Henwood and Stuntz (1987). Although the data used in the NRC reanalysis were specific to bottom otter trawl gear in the U.S. south Atlantic and Gulf of Mexico shrimp fisheries, the authors considered the findings to be applicable to the impacts of forced submergence in general (Sasso and Epperly 2006).

Sea turtle behaviors may influence the likelihood of them being captured in bottom trawl gear. Video footage recorded by the NMFS, Southeast Fisheries Science Center (SEFSC), Pascagoula Laboratory indicated that sea turtles will keep swimming in front of an advancing shrimp trawl, rather than deviating to the side, until they become fatigued and are caught by the trawl or the trawl is hauled up (NMFS 2002). Sea turtles have also been observed to dive to the bottom and hunker down when alarmed by loud noise or gear (Memo to the File, L. Lankshear, December 4, 2007), which could place them in the path of bottom gear such as a bottom otter trawl. There are very few reports of sea turtles dying during research trawls. Based on the analysis by Sasso and Epperly (2006) and Epperly et al. (2002) as well as information on captured sea turtles from past state trawl surveys and the NEAMAP and NEFSC bottom trawl surveys, tow times less than 30 minutes are expected to eliminate the risk of death from forced submergence for sea turtles caught in beam and bottom otter trawl survey gear.

During the spring and fall bottom trawl surveys conducted by the NEFSC from 1963-2017, 85 loggerhead sea turtles were captured. Only one of the 85 loggerheads suffered injuries (cracks to the carapace) causing death. All others were alive and returned to the water unharmed. One leatherback and one Kemp's ridley sea turtle have also been captured in the NEFSC bottom trawl surveys and both were released alive and uninjured. NEFSC bottom trawl survey tows are approximately 30 minutes in duration. All 50 loggerhead, 34 Kemp's ridley, and one green sea turtles captured in the NEAMAP surveys since 2007 have also been released alive and uninjured. NEAMAP surveys operate with a 20-minute tow time. Swimmer et al. (2014) indicates that there are few reliable estimates of post-release mortality for sea turtles because of the many challenges and costs associated with tracking animals released at sea. However, based on the best available information as cited herein, we anticipate that post-release mortality for sea turtles in bottom otter trawl gear where tow times are short (less than 30 minutes) is minimal to non-existent unless the turtle is already compromised to begin with. In that case, the animal would likely be retained onboard the vessel and transported to a rehabilitation center rather than released back into the water.

Estimating Interactions with and Mortality of Sea Turtles

We have considered the available data sets to best predict the number of sea turtles that may be incidentally captured in the proposed trawl surveys. The largest and longest duration data sets for surveys in the general area of the Atlantic Shores South WDA are the NEAMAP and NEFSC bottom trawl surveys. Both surveys occur in the spring and fall using trawl gear. The NEAMAP survey area is farther inshore but overlaps with the control area that will be sampled for the Atlantic Shores trawl surveys while the NEFSC survey area occurs farther offshore and overlaps with the WFA. We have also considered information on interactions with sea turtles and commercial trawl fisheries available from fisheries observer data (Murray 2020).

We reviewed records for sea turtles captured in the NEFSC spring (March-May) and fall (September-October) trawl surveys from 2012-2022 for trawls above 39° N (excluding the Gulf of Maine). This is the geographic area determined to best predict capture rates in a trawl survey carried out in or around the southern New England wind energy areas. For the 2012-2022 fall surveys, three loggerhead sea turtle captures were documented over 1,716 tows; this is a capture rate of 0.00175 loggerhead sea turtles per tow. The NEFSC surveys did not capture any sea turtles during spring surveys in this geographic area; however, the surveys are conducted in early spring, likely before sea turtles arrive in the area. Atlantic Shores is proposing to carry out 45 tows in all four seasons. We do not expect sea turtles to occur in the area during the winter and the NEFSC spring survey data would suggest that no sea turtles would be captured in the spring surveys. Applying the fall capture rate to the 81 summer, spring and fall surveys (as we expect similar abundance of sea turtles in the area in the summer and fall months), results in a prediction of 0.14 loggerheads captured per year or 0.99 loggerheads over the seven year survey period.

Murray (2020) estimated the interaction rates of sea turtles in the US commercial bottom trawl fisheries along the Atlantic coast between 2014-2018 using fisheries observer data. In this analysis, a total of 5,227 days fished were observed from 2014-2018 in bottom trawl fisheries in the Georges Bank and Mid-Atlantic, which represented 13% of commercial trawl fishing effort across both regions. During this period, NEFOP observers documented 50 loggerhead turtle interactions in bottom trawl gear, 48 of which occurred in the Mid-Atlantic; observers also recorded 5 Kemp's ridley turtles, 3 leatherback turtles, and 2 green turtles. These data overlap temporally and spatially with the survey area and the seasons that surveys will occur; however, there are differences in the trawl gear used in commercial fisheries compared to the gear that will be used in the proposed survey. Therefore, because other data sources are available that better align with the proposed surveys, we are not using the interaction rate for commercial trawl fisheries to predict the number of sea turtles likely to be captured in the Atlantic Shores surveys. However, we note that the Murray (2020) dataset demonstrates that all the sea turtle species that occur in the survey area are vulnerable to capture in commercial trawl gear.

The Atlantic Shores trawl survey will use the same trawl design as the NEAMAP survey carried out by the Virginia Institute of Marine Science (VIMS); the NEAMAP survey area overlaps with the Atlantic Shores reference area and is adjacent to the area within the Atlantic Shores South WFA where trawl surveys are proposed. The NEAMAP nearshore trawl survey began in 2007. The majority of captures of sea turtles in the NEAMAP survey (2008-2022) have been loggerheads (50), followed by Kemp's ridley (34). Only one green sea turtle has been captured and there have been no captures of leatherback sea turtles. Sea turtles have been captured in the spring and fall surveys. Using this data to calculate a rate of sea turtle captures per tow[51] and applying that to the number of tows planned by Atlantic Shores, we would predict the capture of 0.9 loggerheads, 0.61 Kemp's ridley, zero leatherbacks, and 0.0018 green sea turtles per year. Over the up to seven-year survey period, we would predict the capture of 6.3 loggerheads, 4.28 Kemp's ridley, zero leatherbacks, and 0.126 green sea turtles.

Given the geographic distribution of the proposed Atlantic Shores surveys, it is likely that the number of sea turtles captured would fall between the number predicted using the NEFSC dataset and the NEAMAP dataset. However, the generally shallow depths of the area where the Atlantic Shores surveys will take place suggests that the NEAMAP survey data would be a better predictor of sea turtle interactions than the NEFSC survey which occurs in deeper, more offshore waters. We note that neither survey has ever captured a leatherback sea turtle; therefore, despite Murray (2020) documenting past captures of leatherback sea turtles in commercial trawl gear and predicting future interaction rates, we do not expect the Atlantic Shores survey to result in the capture of a leatherback sea turtle. Therefore, considering the best available data presented herein, we expect up to 7 loggerheads, up to 5 Kemp's ridleys, and up to 1 green sea turtle will be captured over the seven-year survey period.

Based on the analysis by Sasso and Epperly (2006) and Epperly et al. (2002) discussed above, as well as information on captured sea turtles from past state trawl surveys and the NEAMAP and

[51] Using capture rates of 0.0111 loggerhead per tow, 0.0076 for Kemp's ridley, 0.000 for leatherback, and 0.0002 for green.

NEFSC trawl surveys (no mortalities or serious injuries), a 20-minute tow time for the bottom trawl gear to be used in the proposed Atlantic Shores surveys is expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in the bottom trawl gear. We expect that effects to sea turtles captured in the trawl survey will be limited to minor abrasions from the nets and that these injuries will be fully recoverable with no impacts to the health or fitness of any individual. No serious injury or mortality of any sea turtle is anticipated to occur as a result of the trawl surveys and all captured turtles are expected to be quickly released back into the water alive.

Table 7.5.1. Estimated captures of sea turtles by species from Atlantic Shores trawl surveys over the seven-year duration

Species	Total Estimated Captures Over Seven Years
Loggerhead	7
Kemp's ridley	5
Green	1
Leatherback	0

Effects to Prey

Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish are removed from the marine environment as bycatch in bottom trawls. None of these are typical prey species of leatherback sea turtles or of neritic juvenile or adult green sea turtles. Therefore, the Atlantic Shores trawl surveys will not affect the availability of prey for leatherback and green sea turtles in the action area. Neritic juveniles and adults of both loggerhead and Kemp's ridley sea turtles are known to feed on these species that may be caught as bycatch in the bottom trawls. However, all bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms will shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerheads, which are known to eat a variety of live prey as well as scavenge dead organisms. Given this information, any effects on sea turtles from collection of potential sea turtle prey in the trap/pot gear will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, effects are insignificant.

Atlantic Sturgeon

Factors Affecting Interactions and Existing Information on Interactions

Atlantic sturgeon are generally benthic oriented but while migrating, Atlantic sturgeon may be present throughout the water column and could interact with trawl gear while it is moving through the water column. Atlantic sturgeon interactions with beam and bottom trawl gear are likely at times when and in areas where their distribution overlaps with the operation of the gear. Adult and subadult Atlantic sturgeon may be present in the areas to be surveyed year-round. In the marine environment, Atlantic sturgeon are most often captured in depths less than 50 m. Some information suggests that captures in otter trawl gear are most likely to occur in waters with depths less than 30 m (ASMFC TC 2007). The capture of Atlantic sturgeon in otter trawls used for commercial fisheries is well documented (see for example, Stein et al. 2004b and ASMFC TC 2007).

NEFOP data from Miller and Shepherd (2011) indicates that mortality rates of Atlantic sturgeon caught in commercial otter trawl gear is approximately 5 percent. Atlantic sturgeon are also captured incidentally in trawls used for scientific studies, including the standard NEFSC bottom trawl surveys and both the spring and fall NEAMAP bottom trawl surveys. The shorter tow durations and careful handling of any sturgeon once on deck during fisheries research surveys, compared to commercial fishing operations, is likely to result in an even lower potential for mortality, as commercial fishing trawls tend to be significantly longer in duration. None of the hundreds of Atlantic and shortnose sturgeon captured in past state ocean, estuary, and inshore trawl surveys have had any evidence of serious injury and there have been no recorded mortalities. Both the NEFSC and NEAMAP surveys have recorded the capture of hundreds of Atlantic sturgeon since the inception of each. To date, there have been no recorded serious injuries or mortalities. In the Hudson River, a trawl survey that incidentally captures shortnose and Atlantic sturgeon has been ongoing since the late 1970s; hundreds of individuals of a wide range of sizes have been captured with no mortalities recorded. To date, no serious injuries or mortalities of any sturgeon have been recorded in those surveys.

Estimating Interactions with and Mortality of Sturgeon

We have considered the available data sets to best predict the number of Atlantic sturgeon that may be incidentally captured in the proposed trawl surveys. The largest and longest duration data sets for surveys in the general area of the Atlantic Shores South WDA are the NEAMAP and NEFSC bottom trawl surveys. The NEAMAP survey area is farther inshore but overlaps with the control area that will be sampled for the Atlantic Shores trawl surveys while the NEFSC survey area occurs farther offshore and overlaps with the area within the WFA where the trawl survey is proposed.

We reviewed records for Atlantic sturgeon captured in the NEFSC spring (March-May) and fall (September-October) trawl surveys from 2012-2022 for trawls above 39° N (excluding the Gulf of Maine); this geographic area was considered the best predictor for interaction rates in the southern New England wind energy areas. Three Atlantic sturgeon were captured in the spring surveys from 2012-2022; considering the total of over 1,796 tows, this results in an interaction rate of 0.00167 sturgeon per tow During these same years, 1 Atlantic sturgeon was captured in the fall surveys; considering the total of over 1,716 tows, this results in an interaction rate of 0.00058 sturgeon per tow. Averaging the two interaction rates for a yearly rate, results in an interaction rate of 0.00113 sturgeon per tow. Applying the NEFSC annual interaction rate (0.00113 sturgeon/tow) to the 108 tows planned for the Atlantic Shores surveys predicts 0.122 Atlantic sturgeon captured per year. Over a seven year survey period, this would result in a predicted total capture of 0.852 Atlantic sturgeon.

The NEAMAP survey has captured 492 sturgeon from 2008-2022 and averages 300 tows per year, this equates to a capture rate of 0.109 sturgeon per tow. Using this data, we would predict the capture of 12 Atlantic sturgeon per year in the Atlantic Shores surveys, resulting in a total predicted capture of 84Atlantic sturgeon.

Given the geographic distribution of the proposed Atlantic Shores surveys, it is likely that the number of Atlantic sturgeon captured would fall between the number predicted using the NEFSC dataset and the NEAMAP dataset. However, the generally shallow depths of the area (less than 50 m) where the surveys will take place suggests that the NEAMAP survey data would be a better predictor of sea turtle interactions than the NEFSC survey which occurs in deeper, more offshore waters. Therefore, we have determined that using the NEAMAP data provides the best predictor of the number of Atlantic sturgeon likely to be captured in the Atlantic Shores trawl surveys. As such, we expect up to 84 Atlantic sturgeon will be captured over the seven-year survey period.

As explained in the Status of Species section, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Atlantic sturgeon originating from all five DPSs use the area where trawl gear will be set. The best available information on the composition of the mixed stock of Atlantic sturgeon in Atlantic coastal waters is the mixed stock analysis carried out by Kazyak et al. (2021). The authors used 12 microsatellite markers to characterize the stock composition of 1,704 Atlantic sturgeon encountered across the U.S. Atlantic Coast and provide estimates of the percent of Atlantic sturgeon that belong to each DPS in a number of geographic areas. This study confirmed significant movement of sturgeon between regions irrespective of their river of origin. The Atlantic Shores survey area falls within the "MID Offshore" area described in that paper. Using that data, we expect that Atlantic sturgeon in the area where trawl surveys will occur originate from the five DPSs at the following frequencies: New York Bight (55.3%), Chesapeake (22.9%), South Atlantic (13.6%), Carolina (5.8%), and Gulf of Maine (1.6%) DPSs (Table 7.5.2). It is possible that a small fraction (0.7%) of Atlantic sturgeon in the action area may be Canadian origin (Kazyak et al. 2021); Canadian-origin Atlantic sturgeon are not listed under the ESA. This represents the best available information on the likely genetic makeup of individuals occurring in this area. Using this data, we predict that the up to 84 Atlantic sturgeon expected to be captured in the Atlantic Shores trawl surveys will consist of individuals from the 5 DPSs as described in Table 7.5.2 below. Based on the information presented above and in consideration of the short tow times and priority handling of any sturgeon that are captured in the trawl net, we do not anticipate the serious injury or mortality of any Atlantic sturgeon captured in the trawl gear. Individuals may experience minor abrasions or scrapes but these are expected to be fully recoverable in a short period of time with no effects on individual health or fitness.

Table 7.5.2. Estimated capture of Atlantic sturgeon by DPS in Atlantic Shores trawl survey. DPS percentages listed are the percentage values representing the genetics mixed stock analysis results (Kazyak et al. 2021). Fractions of animals are rounded to whole animals to generate the total estimate.

Bottom Trawl	Total Estimated Captures Over Seven Years
Total	84
New York Bight (55.3%)	47
Chesapeake (22.9%)	19
South Atlantic (13.6%)	11
Carolina (5.8%)	5

Gulf of Maine (1.6%)	2

Estimates derived from NEAMAP Near Shore Trawl Program – Southern Segment data

Effects to Prey
The effects of bottom trawls on benthic community structure have been the subject of a number of studies. In general, the severity of the impacts to bottom communities is a function of three variables: (1) energy of the environment, (2) type of gear used, and (3) intensity of trawling. High-energy and frequently disturbed environments are inhabited by organisms that are adapted to this stress and/or are short-lived and are unlikely to be severely affected, while stable environments with long-lived species are more likely to experience long-term and significant changes to the benthic community (Johnson 2002, Kathleen A. Mirarchi Inc. and CR Environmental Inc. 2005, Stevenson et al. 2004). While there may be some changes to the benthic communities on which Atlantic sturgeon feed as a result of bottom trawling, there is no evidence the bottom trawl activities will have a negative impact on availability of Atlantic sturgeon prey; therefore, effects to Atlantic sturgeon are extremely unlikely to occur.

7.5.3 Assessment of Risk of Interactions with Trap Surveys
As described in Section 3.0, ventless trap gear will be used in a BAG sampling design to evaluate changes in the distribution and abundance of lobster and Jonah crab in the Atlantic Shores South WFA and adjacent reference areas in the Atlantic Shores South WDA to evaluate changes in Jonah crab, lobster, rock crab and assess structure-associated finfish species as bycatch, such as black sea bass, scup, and tautog. The BAG trap survey will be conducted with 12 6-trap trawls in the two impact areas within the Atlantic Shores South WFA and will be sampled twice per season (7-day soaks) for a total of 72 traps sampled eight times per year (576 trap fishing weeks per year). Each trawl will be comprised of unbaited ventless traps. A logarithmic interval spacing sampling design around the WTGs will also be incorporated within the Atlantic Shores ventless trap survey impact area during the operational phase of the project. The purpose of the sampling design is to assess whether lobsters, Jonah crabs, or rock crabs occur in higher abundance near the foundation locations, relative to other locations within the Atlantic Shores ventless trap survey impact area. During the operational phase of the project, twelve foundation locations in the Atlantic Shores ventless trap survey impact area will be selected at random, and six trap trawls of ventless traps will be intentionally set with the first point of the trawl set 15 m away from the WTG and the last at 1,100 m from the WTG. Each randomly selected foundation location will be sampled twice per season (7-day soaks) throughout the year. Trap trawls (multiple traps linked together by sinking groundline) will be used where each trap is spaced in an increasing logarithmic distance from the previous (35 m, 100 m, 250 m, and 700 m apart). All trap gear will follow all applicable regulations and also employ “ropeless” methodology, which will eliminate vertical lines and surface buoys except for when trap trawls will be hauled to the surface by the vessel conducting the survey. No wet storage of trap gear is proposed; as such, the gear will be removed from the water between survey periods and at the end of the survey season.

ESA Listed Whales

Factors Affecting Interactions and Existing Information on Interactions
Any line in the water column, including line resting on or floating above, the seafloor set in areas where whales occur, theoretically has the potential to entangle a whale (Hamilton et al. 2019,

Johnson et al. 2005). Entanglements may involve the head, flippers, or fluke; effects range from no apparent injury to death. Large whales are generally vulnerable to entanglement in vertical and groundlines associated with trap/pot gear.

The general scenario that leads to a whale becoming entangled in gear begins with a whale encountering gear. It may move along the line until it comes up against something such as a buoy or knot. When the animal feels the resistance of the gear, it is likely to thrash, which may cause it to become further entangled in the lines associated with gear. The buoy may become caught in the whale's baleen, against a pectoral fin, or on some other body part. Consistent with the best available information on gear configurations to reduce entanglement risk, all applicable gear modifications and amendments and risk reduction measures will be consistent with the requirements and regulations implementing the Atlantic Large Whale Take Reduction Plan (50 CFR Parts 229 and 697) for the Northeast lobster and Jonah crab trap/pot fisheries. As explained above, there will be no vertical lines attached to the survey gear; thus, there will be no lines between the bottom and the surface. The only lines associated with the surveys will be the sinking groundlines resting on the bottom that are attaching traps together in a trawl.

Sei and Sperm Whales
Sei and sperm whales typically occur in deep, offshore waters near or beyond the continental shelf break; this is well offshore of where the trap and pot surveys will take place. Records of observed sei and sperm whale entanglements are limited due to their offshore distribution, while this may reduce the potential for observations it also reduces the overlap between many fisheries and these species. From 2016-2020, in the western North Atlantic there was 1 mortality, 1 serious injury, and 1 non-serious injury from entanglement for sei whales and no documented interactions between fishing gear and sperm whales (Henry et al. 2022). Although entanglements has been documented for sei whales, the fishing gear in these cases involved the use of buoys/vertical lines which pose a much higher risk to all whale species as the line is present in the entire water column. The use of ropeless gear with only sinking groundlines, greatly reduces any risk to sei and sperm whales given the line is in contact with the seafloor. These species are also rare to the survey area and thus potential for co-occurrence is low.

In order for a sei or sperm whale to be vulnerable to entanglement in the trap survey gear, the whale would have to first co-occur in time and space with that gear, that is it would need to be in the same area that the traps are being fished and the whales would need to be moving along the seafloor and interact with the groundline with either their open mouth, flippers, or tail. During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short time (minutes) as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled. Given the rarity of sei and sperm whales in the survey area, the relatively small amount of gear (12 total trawls with 6 traps each periodically deployed twice per season each year) that will be utilized over the course of five years, and ropeless trap gear (with no vertical lines or buoys) that will be used and thus require a sei or sperm whale to physically interact with the groundline resting on the seafloor, it is extremely unlikely that a sei or sperm whale would encounter this gear; therefore, effects are discountable. We do not expect the entanglement of any sei or sperm whales to occur in the gear set for Atlantic Shores' ventless trap surveys.

Fin and North Atlantic Right Whales

Fin whales and North Atlantic right whales may occur year round in the area where the trap surveys will take place. Fin whales are most likely to occur in the area in the summer (June – September). North Atlantic right whales are most likely to occur in the area from December through May, with the highest probability of occurrence extending from January through April. The trap survey, which will result in gear set intermittently from May – November, will occur at the time of year when the lowest numbers of right whales occur in the survey area.

The Environmental Impact Statement (EIS) prepared for the Atlantic Large Whale Take Reduction Plan (ALWTRP EIS, NMFS 2021b) determined that entanglement in commercial fisheries gear represents the highest proportion of all documented serious and non-serious incidents reported for fin whales and right whales. Entanglement risk primarily occurs with the vertical line of trap/pot gear, but groundlines also pose a risk as right whales have been shown to utilize the entire water column (Hamilton and Kraus 2019). Fin whales may also use the entire water column, however, they are not known to feed right above the seafloor given their feeding mechanism (lunge feeding) and prey (small schooling fish, krill) (Friedlaender et al. 2020). For a fin or right whale to interact with the groundline, it must also interact with the seafloor. In an analysis of the North Atlantic right whale photo-identification catalog, sightings of right whales with seafloor sediment on their bodies showed that between 1980 and 2016, there were 2,053 detections of right whales with 'mud' on their bodies. Although these sightings were throughout their range and in all months, 92.7% of all detections occurred in the Bay of Fundy in the summer (Hamilton and Kraus 2019). Right whale dive behavior demonstrates that whales may be feeding just above the seafloor at times (Baumgartner et al. 2017). There are no records of fin whale entanglements in groundlines. Entanglement in the groundline of trap/pot gear is rare for right whales, as it requires the animal to maneuver themselves under the groundline and then wrap themselves. The use of sinking groundline makes this even less likely to occur.

In order for a fin or right whale to be vulnerable to entanglement in the trap survey gear, the whale would have to first co-occur in time and space with that gear, that is it would need to be in the same area that the traps are being fished and the whales would need to be moving along the seafloor and interact with the groundline with either their open mouth, flippers, or tail in a way that resulted in entanglement. Fin whales are common throughout the southern New England region during the time of year the trap surveys will be conducted, however, fin whales are not known to interact with the seafloor when they feed, and there have not been any interactions of fin whale entanglements in groundlines. During the time of year when the trap surveys will be conducted (May-November), right whales are at their lowest density in the areas where the trap surveys will be conducted. Thus, we expect few instances of overlap in space/time between right whales and the survey gear. Additionally, as established above, entanglement would require an individual to move at least part of its body underneath the sinking groundline and become wrapped.

During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short internment time as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled.

Given the small amount of gear 12 total trawls (BAG survey design) with 6 traps periodically deployed 8 times per year that will be utilized over the course of five years, the ropeless trap gear (with no vertical lines or buoys) that will be used and thus require a fin or right whale to physically interact with the groundline resting on the seafloor, the fact that no fin whale entanglements in groundlines have been reported, and the time of year when surveys will occur is when right whale occurrence is lowest in the survey area, it is extremely unlikely that a fin or right whale would encounter this gear and effects are discountable. No entanglement or other interactions between right or fin whales and the ventless trap survey gear is anticipated.

Effects to Prey
The proposed trap survey activities will not have any effects on the availability of prey for right, fin, sei, and sperm whales. Right whales and sei whales feed on copepods (Perry et al. 1999). Copepods are very small organisms that will pass through trap/pot gear rather than being captured in it. Similarly, fin whales feed on krill and small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002). The size of the trap/pot gear is too large to capture any fish that may be prey for listed whales. Sperm whales feed on deep water species that do not overlap with the study area where trap and pot activities will occur.

Sea Turtles

Factors Affecting Interactions and Existing Information on Interactions
Available entanglement data for sea turtles indicate they may be vulnerable to entanglement in trap/pot gear, primarily the vertical lines; however, the trap gear used for the Atlantic Shores survey will not use vertical lines. Thus the only entanglement risk to sea turtles is the sinking groundline. Sea turtles in the survey area are too big to be caught in the traps themselves since the vents/openings leading inside are far smaller (5 inches) than any of these species. Given data documented in the GAR STDN database, leatherback sea turtles seem to be the most vulnerable turtle to entanglement in vertical lines of fixed fishing gear in the action area. Long pectoral flippers may make leatherback sea turtles more vulnerable to entanglement. In 2007, a leatherback sea turtle was entangled in the lines connecting whelk pots (GAR STDN, unpublished data).

Leatherbacks entangled in fixed gear are often restricted with the vertical buoy line wrapped tightly around the flippers multiple times suggesting entangled leatherbacks are typically unable to free themselves from the gear (Hamelin et al. 2017). Leatherback entanglements in trap/pot gear may be more prevalent at certain times of the year when they are feeding on jellyfish in nearshore waters (i.e., Cape Cod Bay) where trap/pot fishing gear is concentrated. Hard-shelled turtles also entangle in vertical lines of trap/pot gear. Due to leatherback sea turtles large size, they likely have the strength to wrap fixed fishing gear lines around themselves, whereas small turtles such as Kemp's ridley or smaller juvenile hard-shelled turtles likely do not. However, entanglement in the groundline of trap/pot gear is rare as it requires the animal to maneuver themselves under the groundline and then wrap themselves.

Records of stranded or entangled sea turtles show entanglement of trap/pot lines around the neck, flipper, or body of the sea turtle; these entanglements can severely restrict swimming or feeding (Balazs 1985). Constriction of a sea turtle's neck or flippers can lead to severe injury or mortality. While drowning is the most serious consequence of entanglement, constriction of a sea turtle's flippers can amputate limbs, also leading to death by infection or to impaired foraging or swimming ability. If the turtle escapes or is released from the gear with line attached, the flipper may eventually become occluded, infected, and necrotic. Entangled sea turtles can also be more vulnerable to collision with boats, particularly if the entanglement occurs at or near the surface (Lutcavage et al. 1997).

Estimating Interactions with Sea Turtles

Small turtles such as Kemp's ridley or smaller juvenile hard-shelled turtles likely do not have the strength to maneuver themselves under the groundline and then wrap themselves in it. Due to the size of Kemp's ridley and green sea turtles in the areas where the trap survey will be conducted, interactions with these species in the groundlines of the trap gear are extremely unlikely to occur.

Larger turtles such as loggerhead turtles or leatherback turtles may forage along the seafloor and have the strength to maneuver themselves under the groundline and then wrap themselves in it, however, given the groundline is in contact with the seafloor it is unlikely sea turtles would come in contact with it. This risk is further reduced by the small amount of gear that will be set and the short duration that it will be present. During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short internment time as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled. Based on this information, it is extremely unlikely that loggerhead or leatherback turtles will be captured or entangled in the trap gear deployed as part of the proposed surveys. Therefore, effects are discountable and we do not expect any sea turtles to be entangled in the proposed trap survey.

Effects to Prey

Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish may be removed from the marine environment as bycatch in trap/pot gear. None of these are typical prey species of leatherback sea turtles or of neritic juvenile or adult green sea turtles. Therefore, the Atlantic Shores trap survey will not affect the availability of prey for leatherback and green sea turtles in the action area. Neritic juveniles and adults of both loggerhead and Kemp's ridley sea turtles are known to feed on these species that may be caught as bycatch in the trap/pot gear. However, all bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms will shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerheads, which are known to eat a variety of live prey as well as scavenge dead organisms. Given this information, any effects on sea turtles from collection of potential sea turtle prey in the trap/pot gear will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, effects are insignificant.

Atlantic Sturgeon

Factors Affecting Interactions and Existing Information on Interactions

Entanglement or capture of Atlantic sturgeon in trap gear is extremely unlikely. To become captured or entangled in the trap gear, sturgeon would either need to enter the trap or become wrapped in the sinking groundline between each trap. A review of all available information resulted in several reported captures of Atlantic sturgeon in trap/pot gear in Chesapeake Bay as part of a reward program for reporting Atlantic sturgeon in Maryland, yet all appeared to be juveniles no greater than two feet in length. Juvenile Atlantic sturgeon do not occur in the area where the Atlantic Shores surveys will take place. In addition, there has been one observed interaction, in 2006, on a trip where the top landed species was blue crab (NEFSC observer/sea sampling database, unpublished data). No incidents of trap/pot gear captures or entanglements of sturgeon have been reported in ten federal fisheries ((1) American lobster, (2) Atlantic bluefish, (3) Atlantic deep-sea red crab, (4) mackerel/squid/butterfish, (5) monkfish, (6) Northeast multispecies, (7) Northeast skate complex, (8) spiny dogfish, (9) summer flounder/scup/black sea bass, and (10) Jonah crab fisheries), the proposed surveys conducted by Atlantic Shores are aimed to replicate a number of these fisheries to assess the impact of offshore wind development in the WDA. The traps used in the survey are 15 in high, 43.5 in long, and 22 in wide with 5-inch entrance hoops and constructed with 1.5-in mesh, given these dimensions an adult sturgeon would not be able to enter the 5-inch entrance hoop and thus capture is extremely unlikely to occur. Although Atlantic sturgeon may feed along the seafloor in the Atlantic Shores South WDA, we do not expect them to move beneath the sinking groundline and then wrap themselves in the groundline and become entangled. Based on this information, it is extremely unlikely that Atlantic sturgeon from any DPS will be captured or entangled in the trap gear deployed as part of the proposed surveys. Therefore, effects are discountable and we do not expect the entanglement of any Atlantic sturgeon.

Effects to Prey

The trap and pot gear that will be used to assess lobster and crab species and structure-associated fish species are considered to have low impact to bottom habitat, and is unlikely to incidentally capture Atlantic sturgeon invertebrate prey. Given this information, it is extremely unlikely the trap/pot activities conducted by Atlantic Shores will have an effect on Atlantic sturgeon prey.

7.5.4 Assessment of Risk of Interactions with Clam Surveys

Atlantic Shores proposes to conduct clam surveys in the Project area and at two control sites once per year in the summer for 5 years to collect data on quahog and surf clam resources. A towed modified sampling dredge will be pulled by a contracted scientific research vessel at 16 stations within the Project area and 16 stations at each of the 2 control sites (48 tows total per year). Tows will be conducted for 5 minutes at a speed of 3 knots (1.5 m/s) for a total of 240 minutes of dredging per survey trip (i.e., 80 minutes each in the Project area and at each control sites). The clam survey will result in temporary disturbance of the benthos and a potential temporary loss of benthic resources. Tows for the clam survey will affect an extremely small area at each of the survey locations. The vessel will pull the dredge approximately 1,476 ft. (450 m) before being raised and deployed to the next survey location, totaling 70,866 feet (21,600 m) per sampling event. The hydraulic clam dredge used during clam surveys will inject highly pressurized water into the sediment to a depth of 5 in, depending on the coarseness of the sediment and the amount of water pressure needed to dislodge the clams from the bottom. The clam dredge creates a trench that is as wide as the dredge (10’ 7”) with mounds along the sides. Fine sediments are re-suspended in the water column, creating a turbidity cloud that dissipates quickly. We expect the trenches to degrade within a few months to the point when they are no longer visible. While there may be some loss of benthic and bentho-pelagic species at the survey sites, including potential forage items for listed species that feed on benthic and pelagic resources, the amount of resources potentially lost will be extremely small. Any loss of benthic forage items for ESA listed species will be small, temporary, and localized. These temporary, isolated reductions in the amount of benthic resources are not likely to have a measurable effect on the availability of prey items for ESA listed species.

For all clam surveys, a 15-minute monitoring period will be conducted to reduce the risk of interaction between ESA listed species and the research gear. If ESA listed species are sighted during the survey, then the sampling station will either be moved or canceled or the activity suspended until there are no sightings of any ESA listed species for 15 minutes within 0.5 nm (926 m) of the survey location. In the Greater Atlantic Region (Maine through Virginia), formal ESA Section 7 consultations have been conducted on the effects of clam surveys carried out by NEFSC. In each of the Opinions for these clam surveys, we did not expect captures of ESA listed species. Additionally, NMFS authorizes the operations of the surf clam/ocean quahog fishery in the Lease Area under the authority of the Magnuson-Stevens Fishery Conservation and Management Act and through Fishery Management Plans and their implementing regulations. We have completed Biological Opinions on the operations of the surf clam/ocean quahog fishery, and in each of these Opinions, we determined that the fishery does not adversely affect any ESA listed species or their designated critical habitats (NMFS 2010b, 2017h, 2020e). To date, there have been no observed or documented interactions of any ESA listed species with hydraulic clam dredges. Because the NEFSC clam surveys and the Atlantic surf clam/ocean quahog fishery have a long history, it is reasonable to rely on a lack of captures in the past to indicate that captures in Atlantic Shores South's proposed Fishery Monitoring Plan are also unlikely.

The short soak time, slow vessel speed, and the pre-deployment and continued observation for ESA listed species makes the risk of interaction with ESA listed species extremely unlikely to occur. Based on the analysis herein, it is extremely unlikely that any ESA listed species will interact with the clam survey activities; and any effects to ESA listed species because of the clam surveys are extremely unlikely to occur.

7.5.5 Impacts to Habitat

Here we consider any effects of the proposed marine resource survey and monitoring activities on habitat of listed species. The SPI/PV equipment and ventless traps will be set on the ocean floor, which could result in disturbance of benthic resources. Acoustic receivers and moored PAM systems may include a lander or anchor that would rest on the seafloor. However, the size of the area that would be disturbed by setting this gear is extremely small and any effects to benthic resources would be limited to temporary disturbance of the bottom in the immediate area where the gear is set. Although ventless traps will rest on the seafloor, Carmichael et al. (2015) found that traps have little or low impact on bottom habitat. In an analysis of effects to habitat from fishing gears, mud and sand habitats were found to recover more quickly than courser substrates (see Appendix D in NEFMC 2016, NEFMC 2020). No effects to any ESA listed species are anticipated to result from this small, temporary, intermittent, disturbance of the bottom sediments.

An assessment of fishing gear impacts found that mud, sand, and cobble features are more susceptible to disturbance by trawl gear, while granule-pebble and scattered boulder features are less susceptible (see Appendix D in NEFMC 2016, NEFMC 2020). Geological structures generally recovered more quickly from trawling on mud and sand substrates than on cobble and boulder substrates; while biological structures (i.e. sponges, corals, hydroids) recovered at similar rates across substrates. Susceptibility was defined as the percentage of habitat features encountered by the gear during a hypothetical single pass event that had their functional value reduced, and recovery was defined as the time required for the functional value to be restored (see Appendix D in NEFMC 2016, NEFMC 2020). The clam dredging and otter trawl gear will also interact with the ocean floor and may affect bottom habitat in the areas surveyed. However, given the infrequent survey effort, the limited duration of the surveys, and the very small footprint, any effects to ESA listed species resulting from these minor effects to benthic habitat will be so small that they cannot be meaningfully measured, evaluated, or detected.

7.6 Consideration of Potential Shifts or Displacement of Fishing Activity

As described in section 7.2 (*Effects of Project Vessels*) the lease area and the area along the cable corridors support commercial and recreational fishing activity throughout the year at low to moderate levels compared to the larger surrounding region (Atlantic Shores COP 2022). Fishing activity includes a variety of fixed gear (e.g. gillnets, pot/traps) and mobile gear fisheries (e.g. trawl (bottom and mid-water) and dredge (clam and scallop)), as well as hook and line. A variety of species are targeted including sea scallops, Menhadens, surfclam, Quahog, blue crab, shortfin squid, summer flounder, longfin squid, black sea bass, American lobster, monkfish, and scup (BOEM DEIS 2023). Fishing effort is highly variable due to factors including target species distribution and abundance, environmental conditions, fishing regulations, season, and market value. Within the New Jersey Wind Energy Study Area, which includes the Atlantic Shores lease area, the clam dredge, targeting Atlantic surfclam and ocean quahog, was the primary commercial fishing gear utilized in terms of value and landings. The primary landed commercial species in tonnage was the Atlantic surfclam, whereas the Atlantic sea scallop was the most economically valuable species within the New Jersey Wind Energy Study Area (NJDEP 2010b). As described in the COP, based on the VMS data for the most recent set of years, commercial species harvested in the lease area consist primarily of Atlantic sea scallop, surfclam, and ocean quahog; based on the VMS data for all of these target species, most of the commercial fishing activity, including the scallop fishery, is located outside the Atlantic Shores Lease Area, typically in waters further offshore. As addressed in sections 5 (*Status of the Species*) and 6 (*Environmental Baseline*) of this Opinion, interactions between fishing gear (e.g., bycatch, entanglement) and listed whales, sea turtles, and Atlantic sturgeon occur throughout their range and may occur in the action area.

Here, we consider how the potential shift or displacement of fishing activity from the lease area and cable corridors, because of the proposed project, may affect ESA-listed whales, sea turtles, and Atlantic sturgeon. As described in section 3.6.1.3 of the DEIS, potential impacts to fishing activities in the lease area and along the cable corridors during the construction phase of the proposed project are primarily related to accessibility (BOEM DEIS 2023). During the construction and decommissioning phases, potential effects to fishing operations include displacement of vessel transit routes and shifts in fishing effort due to disruption in access to fishing grounds in the areas where construction activities will occur due to the presence of Project vessels and construction activities. Impacts to fishing operations during the operational phase may result from changes in habitat conditions and perceived or real access challenges.

While changes in distribution and abundance of species targeted by commercial fisheries could occur during construction due to exposure to increased sediment, noise, and vibration, these effects are anticipated to be short-term and localized and not result in any changes in abundance or distribution of target species that would be great enough to result in changes in patterns of fishing activity. To the extent that construction has negative effects on the reproductive success of commercial fish species (e.g., longfin squid spawning), there is the potential for a decrease in fish abundance and future consequences on fishing activity. Impacts during the decommissioning phase of the Project are expected to be similar. Displacement of fishing vessels and shifts in operations during the construction and decommissioning phases that are related to a shift or change in target species distribution and abundance are expected. Although the magnitude of the shifts is unknown based on the natural variability of the fisheries, fisheries impacts related to habitat impacts are likely to be related to the footprint of temporary and permanent disturbance (6,720 acres of temporary disturbance and 1,382 acres of permanent disturbance) impacted by construction or decommissioning and short construction and decommissioning periods (2-3 years each) (BOEM DEIS 2023).

During the operational phase of the project, the potential impacts to fishing activity are primarily anticipated from potential accessibility issues due to the presence and spacing of WTGs and the OSSs as well as potential avoidance of the inter-array and export cable routes due to concerns related to avoiding the potential for snags or other interactions with the cable or cable protection. Additionally, there may be localized impacts on the abundance and distribution of some target species due to changes in habitat conditions (e.g., foundations and scour protection, noise and vibration associated with turbine operations, consequences of reef effect resulting in changes in localized species composition). While there are no restrictions proposed for fishing activity in the WDA, the presence and spacing of structures (less than 1x1 nautical miles) may impede fishing operations for certain gear types. Additionally, as explained in section 7.4, the structures will provide new hard bottom habitat in the WDA creating a "reef effect" that may attract fish and, as a result, fishermen, particularly recreational anglers and party/charter vessels. This could create vessel congestion and could dissuade commercial vessels from fishing among the structures.

The potential for shifts in fishing effort due to the proposed project is expected to vary by gear type and vessel size. Of the gear types that fish within the lease area and cable corridors are likely to encounter, bottom tending mobile gear is more likely to be displaced than fixed gear, with larger fishing vessels using dredges and trawl gear, including mid-water trawl gear, more likely to be displaced compared to smaller fishing vessels using similar gear types that may be easier to maneuver. However, even without any area use restrictions, there may be different risk tolerances among vessel captains that could lead to at least a temporary reduction in fishing effort in the lease area and along the cable corridors during construction and decommissioning activities, and longer-term reduction of fishing effort during the operational phase of the project. Space use conflicts due to displacement of commercial fishing activity from the lease area to surrounding waters could cause a temporary or permanent reduction in such fishing activities within the lease area and an increase in fishing activities elsewhere. Additionally, there could be increased potential for gear conflicts within the lease area as commercial fisheries and for-hire and private recreational fishing compete for space between turbines, especially if there is an increase in recreational fishing for structure-affiliated species attracted to the foundations (e.g., black sea bass). Fixed gear fisheries, such as the monkfish and spiny dogfish gillnet fishery, may resume or even increase fishing activity in the lease area and along the cable corridors shortly after construction because these fisheries are relatively static (i.e., relatively stationery in location), though there may be small shifts in gear placement to avoid areas very close to project infrastructure. Mobile fisheries, such as surfclam and sea scallop dredging and squid trawl fisheries may take longer to resume fishing activity within the lease area or along the cable corridors as the physical presence of the new Project infrastructure may alter the habitat, behavior of fishing vessels, and target species. However, for all fisheries, any changes in fishing location are expected to be limited to moves to nearby, geographically adjacent areas, particularly on the fringes of the lease area, given the distribution of target species and distance from home ports, all of which limit the potential for significant geographic shifts in distribution of fishing effort. For example, if fishing effort were to shift for surfclams, effort may shift northeast outside of the lease area to other areas of similar surfclam availability east of Cape May and Atlantic City.

Fishing vessel activity (transit and active fishing) is high throughout the Mid-Atlantic Bight as a whole, with higher levels of effort occurring outside of the WDA than within the WDA (see section 7.4.2.2 of the COP). The scale of the proposed Project (no more than 200 WTG foundations plus the OSSs and met tower) and the footprint of the lease area (102,136 acres, with project foundations and associated scour protection occupying only a small fraction of that) relative to the size of available fishing area are small. Fishing activity will not be legally restricted within the lease area and the proposed spacing of the turbines could allow for fishing activity to occur, depending on the risk tolerance of the operator and weather conditions. Any reduction in fishing effort in the lease area would reduce the potential for interactions between listed species and fishing gear in the lease area, yet any beneficial effect would be expected to be so small that it cannot be meaningfully measured, evaluated, or detected. Similarly, any effects to listed species from shifts of fishing effort to areas outside of the WDA are also expected to be so small that they cannot be meaningfully measured, evaluated, or detected. This is because any potential shifts are expected to be limited to small changes in geographic area and any difference in the risk of interaction between fishing gear and listed species is expected to be so small that it cannot be meaningfully measured, detected, or evaluated.

As explained in Section 7.4 above, the presence of new structures (e.g., WTGs and OSS foundations) may also act as artificial reefs and could theoretically attract a range of species, including listed species such as sea turtles and sturgeon if the foundations serve to aggregate their prey. As explained in section 7.4, any changes in biomass around the foundations are expected to be so small and localized that they would have insignificant effects on the distribution, abundance, and use of the lease area by listed sea turtles or Atlantic sturgeon. We do not expect that any reef effect would result in any increase in species preyed on by North Atlantic right, fin or sei whales and note that sperm and blue whales are generally not expected to forage in the shallow waters of the lease area. As noted previously, we do not expect any effects on the distribution, abundance, or use of the lease area by ESA listed whales that would be attributable to the physical presence of the foundations.

This potential increase in biomass around the new structures of the Atlantic Shores South Wind Farm may result in an increase in recreational anglers targeting structure affiliated fish species and subsequently may increase incidental interactions between recreational anglers and listed species. At the Block Island Wind Farm (Rhode Island), and other offshore wind farms in Europe, recreational fishermen have expressed a generally positive sentiment about the wind farm as an enhanced fishing location due to the structures as there are no other offshore structures or artificial reefs in surrounding waters (Hooper, Hattam & Austern 2017, ten Brink & Dalton 2018, Smythe, Bidwell & Tyler 2021). Interactions between listed species, particularly sea turtles, and recreational fishing do occur, especially in areas where target species and listed species co-occur (Rudloe & Rudloe 2005, Seney 2016, Swingle et al. 2017, Cook, Dunch & Coleman 2020). Listed sea turtles may be attracted to the structures of the foundations to forage and seek refuge and also may be attracted to bait used by anglers, depending on species.

The area where the proposed Atlantic Shores South Wind Farm is planned to be built is comprised of three sub-regions including the Great Egg Shelf Valley, the Mullica River Channel, and the Hudson Shelf Valley areas (Atlantic Shores COP 2023). The habitat is primarily composed of sand bedforms of varying sizes and swales with increased gravel and gravelly deposits to the north and west of the Lease Area, and it supports a moderate level of recreational fishing activity, primarily in the summer (Atlantic Shores COP 2023). If there is an increase in recreational fishing in the lease area, it is likely that this will represent a shift in fishing effort from areas outside the lease to within the lease and/or an increase in overall effort. Given the limited number of WTGs (200) proposed to be installed and vessel safety concerns regarding being too close to foundations and other vessels, the likelihood of a significant number of recreational fishermen aggregating around the same turbine foundation at the same time is low. It is not likely that targeted recreational fishing pressure will increase to a point of causing a heightened risk of negative impact for any listed species; that is, effects will be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant.

Whales colliding/hitting vessels, primarily recreational vessels engaged in fishing activities is uncommon to begin with, but can happen[52], primarily when prey of whales and species targeted by fishermen co-occur. As mentioned in section 7.4.3.1, it is expected whales will be able to transit the lease area freely given the spacing between turbine foundations and as explained in section 7.4.3.2, turbine foundations are not expected to cause an increase in prey that would then result in greater co-occurrence of prey, target species, whales, and vessels and thus risk of whales colliding with vessels engaged in fishing. We expect the risk posed to protected species from any shifts and/or displacement of recreational fishing effort caused by the action to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. For the same reasons, we do not expect any increased vessel strike risk from fishing vessels and Atlantic sturgeon or sea turtles.

[52] https://boston.cbslocal.com/2021/07/13/block-island-whale-boat-rescue/

In summary, we expect the risks of entanglement, bycatch, or incidental hooking interactions due to any shifts or displacement of recreational or commercial fishing activity caused by the proposed Project to be so small that they cannot be meaningfully measured, evaluated, or detected; therefore, effects to listed species are insignificant.

7.7 Repair and Maintenance Activities

Atlantic Shores South personnel conducting O&M activities would access the lease area on an as-needed basis. With no personnel living offshore, the WTGs and OSS would be remotely monitored and controlled by the Supervisory Control and Data Acquisition (SCADA) system, which connects the WTGs to the OSS and the OSS to the Atlantic Shores South Export Cable-Interconnection Facility with fiber optic cables that would be embedded in the inter-array and export cables. Personnel would not be required to be present except to inspect equipment and conduct repairs. Effects of vessel traffic associated with repairs and maintenance during the operations phase is considered in the *Effects of Project Vessels* section above. Effects of noise associated with project vessels and aircraft are addressed in the acoustics section above; these effects were determined to be insignificant.

Project components would be inspected within a 5-year timeframe. Underwater inspection would include visuals and eddy current tests conducted by divers or remotely operated vehicles. Effects of inspections and associated surveys are considered in sections 7.1 and 7.5 above. As described in the COP, Atlantic Shores South expects that project components will undergo at least annual inspections, with routine/planned, and unanticipated maintenance occurring over the life of the project.

BOEM has indicated that given the burial depth of the inter-array cable and the Atlantic Shores South Export Cable-Offshore, displacement, or damage by vessel anchors or fishing gear is unlikely. Mechanical inspections of the Atlantic Shores South Export Cable would include a cable burial assessment and debris field inspection. Atlantic Shores South would perform mechanical inspections on a 5-year basis or following a storm event that may necessitate an unplanned inspection. In the event that cable repair was necessary due to mechanical damage, it could be necessary to remove a portion of the cable and splice in a new section. We determined that acoustic and habitat based effects of cable installation would be insignificant or extremely unlikely to occur; as any cable repair will essentially follow the same process as cable installation except in only a small portion of the cable route and for a shorter period of time, we expect that the effects will be the same or less and therefore would also be insignificant.

Based on our review of the planned repair and maintenance activities described in the BA, DEIS, and COP, no additional effects beyond those considered in the previous sections of this Opinion are anticipated to result from repair and maintenance activities over the life of the project (Atlantic Shores COP 2023).

7.8 Unexpected/Unanticipated Events

In this section, we consider the “non-routine activities and low probability events” that were identified by BOEM in the DEIS (section 2.3). These events, while not part of the proposed action, include collisions between vessels, allisions (defined as a strike of a moving vessel against a stationary object) between vessels and WTGs or the OSS, failure of WTGs due to a weather event or seismic activity, and accidental spills.

7.8.1 Vessel Collision/Allision with Foundation

A vessel striking a wind turbine theoretically could result in a spill or catastrophic failure/collapse of the turbine. However, there are several measures in place that ensure such an event is extremely unlikely to occur. These include: inclusion of project components on nautical charts which would limit the likelihood of a vessel operator being unaware of the project components while navigating in the area; compliance with lighting and marking required by the USCG which is designed to allow for detection of the project components by vessels in the area; and, spacing of turbines to allow for safe navigation through the project area. Because of these measures, a vessel striking a turbine foundation or the OSS is extremely unlikely to occur. The Navigational Risk Assessment prepared for the project reaches similar conclusions and determined that it is highly unlikely that a vessel will strike a foundation and even in the unlikely event that such a strike did occur, the collapse of the foundation is highly unlikely even considering the largest/heaviest vessels that could transit the lease area. Therefore, based on this information, any effects to listed species that could theoretically result from a vessel collision/allision are extremely unlikely and thus discountable.

7.8.2 Failure of WTGs due to Weather Event

As explained in the Atlantic Shores COP (2023) and DEIS (section 2.3), Atlantic Shores South designed the proposed Project components to withstand severe weather events. The WTGs are equipped with safety devices to ensure safe operation during their lifetime. These safety devices may vary depending on the WTG selected and may include vibration protection, over speed protection, and aerodynamic and mechanical braking systems, as well as electrical protection devices.

Few hurricanes pass through the Mid-Atlantic, and according to the historical record, a hurricane comes within 90-170 miles of New Jersey every 3-4 years (BOEM 2022). The area is subjected to frequent Nor'easters that form offshore between Georgia and New Jersey, and typically reach maximum intensity in New England. These storms are usually characterized by winds from the Northeast, heavy precipitation, wind, storm surges, and rough seas. As described in the Navigation Safety Risk Assessment (Baird 2022, COP Appendix II-S), during the spring and summer seasons, winds are generally from the southwest and are typically less than 25 mph (11.1 m/s) with the strongest winds during the winter, with winds from the northwest routinely reaching 30 mph (13.41 m/s) and a peak speed of 46.3 mph (20.7 m/s). Although hurricanes are relatively infrequent in the Mid-Atlantic, wave heights in the region of the lease area average at 4.05 feet (1.23 m) with a maximum wave height of 28 feet (8.4 m) (Baird 2022, COP Appendix II-S). Atlantic Shores South does not foresee a hazard to the integrity of WTGs due to ice accumulation because, should ice accumulate on WTG blades, the weight and center of mass of the blade would change causing an imbalance in the rotor. Should the rotor continue to rotate, it would vibrate, and vibrational sensors installed in the WTG would automatically trigger the WTG to shut down.

BOEM has indicated that the proposed WTGs will meet design criteria to withstand extreme weather conditions that may be faced in the future and include consideration of 50 and 100-year 10 minute wind speed values and ocean forces. The 50-year 10 minute wind speed is estimated to be 96 knots and the 100-year 10 minute wind speed is estimated to be 105 knots. (A 100-year 10-minute wind speed means there is a 1-percent chance of that event occurring in any given year, similarly a 50-year wind speed means there is a 2% chance of that happening in any given year.). The design will also be in accordance with various standards including International Electrotechnical Commission (IEC) 61400-1 and 61400-3. These standards require designs to withstand forces based on a 50-year return interval for the turbines, and 100-year return interval for electrical substation platforms. The requirements for extreme metocean loading are based on 50-yr return interval site-specific conditions for most operating load cases with a 500-yr abnormal "robustness" load case check (a 500-year event has a 0.2% chance of occurring in any given year). In the DEIS, BOEM states that the design standards are adequate even considering the predicted increase in hurricane activity that is anticipated to result from climate change (BOEM DEIS 2023).

Given that the project components are designed to endure wind and wave conditions that are far above the maximum wind and wave conditions recorded at the nearest weather monitoring buoy to the project, and exceed conditions for which there is only a 1% chance of occurring in any year (100-year event), it is not reasonable to conclude that project components will experience a catastrophic failure due to a weather event over the next 25 years. In other words, project components have been designed to withstand conditions that are not expected to occur more than once over the next 100 years (e.g., exceeding 100-year 10 minute wind speed values and ocean forces). As a catastrophic failure would require conditions that are extremely unlikely to occur, even considering projections of increased hurricane activity related to climate change projections over the next 25 years, any associated potential impacts to listed species are also extremely unlikely to occur and effects are discountable.

7.8.3 Failure of WTGs due to Seismic Activity

There are multiple fault lines within the vicinity of New Jersey; however, the largest and most prominent is the Ramapo Fault. Running southwest to northeast, it spans the northern portion of the state and has approximate endings near Schaefferstown, PA and Haverstraw, NY. The most significant earthquake in New Jersey was in 1783, with a magnitude of 5.3 and had an epicenter west of New York City. Earthquakes have occurred as far south as Salem County (Michael Baker International 2019), which is located in the western portion of the state and approximately 107 km from the project area. Since 1783, the recorded earthquakes within 160 km of the project area have been below a 4.0 in magnitude, meaning that while they are sufficient to be felt, they are unlikely to cause damage (Atlantic Shores COP 2023). The distance between the project area and local fault lines is such that events such as fault rupture, where fault movements are significant enough to breach the surface (which only occurs in a portion of earthquakes) are unlikely to occur in the lease area; therefore, effects to listed species are extremely unlikely to occur and are discountable.

7.8.4 Oil Spill/Chemical Release

As explained in the Oil Spill Response Plan (OSRP) (Atlantic Shores COP 2023, Appendix I-D), the worst-case discharge scenario would be a structural failure of the offshore substation. A structural collapse would cause a subsequent rupture of the transformers oil reservoir (185,015 gallons) and the generator’s diesel tank (20,000 gallons) for a total release of 205,015 gallons. Similarly, the structural failure of a WTG resulting in collapse and damage that released oil products would in the worst case, release 3,781 gallons of oil products in the ocean. The risk of a spill in the extremely unlikely event of a collapse is limited by the containment built into the structures. Both the WTGs and OSSs have been designed with a minimum of 110% of secondary containment of all identified oils, grease, and lubricants (Atlantic Shores COP 2023, Appendix I-D). As explained above, catastrophic loss of any of the structures is extremely unlikely; therefore, the spill of oil from these structures is also extremely unlikely to occur. Modeling presented by BOEM in the BA (from Bejarano et al. 2013) indicates that there is a 0.01% chance of a "catastrophic release" of oil from the wind facility in any given year. Given the 25-year life of this project, the modeling supports our determination that such a release is extremely unlikely to occur.

The Bejarano et al. (2013) modeling indicates the only incidents calculated to occur within the life of the Proposed Action are spills of up to 90 to 440 gallons (340.7 to 1,665.6 liters) of WTG fluid or a diesel fuel spill of up to 2,000 gallons (7,570.8) with model results suggesting that such spills would occur no more frequently than once in 10 years and once in 10-50 years, respectively. However, this modeling assessment does not account for any of the spill prevention plans that will be in place for the project which are designed to reduce risk of accidental spills/releases. Considering the predicted frequency of such events (i.e., no more than 3 WTG fluid spills over the 25-year life of the WTGs and no more than one diesel spill over the life of the project), and the reduction in risk provided by adherence to USCG and BSEE requirements as well as adherence to the spill prevention plan both of which are designed to eliminate the risk of a spill of any substance to the marine environment, we have determined that any fuel or WTG fluid spill is extremely unlikely; as such, any exposure of listed species to any such spill is also extremely unlikely to occur and thus discountable.

7.9 Project Decommissioning

As described in the BA and DEIS, under 30 CFR Part 285 and commercial Renewable Energy Lease OCS-A 0499, Atlantic Shores South would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Project within 2 years of the termination of its lease. All facilities would need to be removed 15 feet (4.6 meters) below the mudline unless otherwise authorized (30 CFR § 585.910(a)). The portion buried below 15 feet (4.6 meters) would remain, and the depression refilled with the temporarily removed sediment. BOEM expects that WTGs and the OSS would be disassembled and the piles cut below the mudline. Atlantic Shores South would clear the area after all components have been decommissioned to ensure that no unauthorized debris remains on the seabed. A cable-laying vessel would be used to remove as much of the inter-array and Atlantic Shores South Export Cable transmission cables from the seabed as practicable to recover and recycle valuable metals. Cable segments that cannot be easily recovered would be left buried below the seabed or rock armoring.

Information on the proposed decommissioning is very limited and the information provided to us in the BA, DEIS, and COP limits our ability to carry out a thorough assessment of effects on listed species. Here, we evaluate the information that is available on the decommissioning. As described in the DEIS, prior to the expiration of the lease (or after completion of the commercial activities on the lease), Atlantic Shores South would be required to submit a decommissioning application to BSEE. This would be subject to an approval process that is independent of the proposed COP approval. BOEM indicates in the DEIS that the approval process will include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Atlantic Shores South would need to obtain separate and subsequent approval from BOEM to retire any portion of the Proposed Action in place. Given that approval of the decommissioning application will be a discretionary Federal action, albeit one related to the present action, we anticipate that a determination will be made based on the best available information at that time whether reinitiation of this consultation is necessary to consider effects of decommissioning that are different from those considered here.

As described in section 6.2 of the COP, it is anticipated that the equipment and vessels used during decommissioning will likely be similar to those used during construction and installation (Atlantic Shores COP 2023). For offshore work, vessels would likely include cable laying vessels, crane barges, jack-up barges, larger support vessels, tugboats, crew transfer vessels, and possibly a vessel specifically built for erecting WTG structures. Effects of the vessel traffic anticipated for decommissioning are addressed in the vessel effects section of this Opinion. As described below, we have determined that all other effects of decommissioning will be insignificant.

As described in the COP (2023), if cable removal is required, the first step of the decommissioning process would involve disconnecting the inter-array 170kV cables from the WTGs. Next, the inter-array cables would be pulled out of the J-tubes or similar connection and extracted from their embedded position in the seabed. In some places, in order to remove the cables, it may be necessary to jet plow the cable trench to fluidize the sandy sediments covering the cables. Then, the cables will be reeled up onto barges. Lastly, the cable reels will then be transported to the port area for further handling and recycling. The same general process will likely be followed for the 275 kV offshore export cable. If protective concrete mattresses or rocks were used for portions of the cable run, they will be removed prior to recovering the cable. We determined that acoustic and habitat based effects of cable installation would be insignificant or extremely unlikely to occur; as the cable removal will essentially follow the same process as cable installation except in reverse, we expect that effects will be the same and therefore would also be insignificant or extremely unlikely to occur.

Prior to dismantling the WTGs, they would be properly drained of all lubricating fluids, according to the established operations and maintenance procedures and the OSRP. Removed fluids would be brought to the port area for proper disposal and/or recycling. Next, the WTGs would be deconstructed (down to the transition piece at the base of the tower) in a manner closely resembling the installation process. The blades, rotor, nacelle, and tower would be sequentially disassembled and removed to port for recycling using vessels and cranes similar to those used during construction. It is anticipated that almost all of the WTG will be recyclable, except possibly for any fiberglass components. After removing the WTGs, the steel transition pieces and foundation components would be decommissioned.

Sediments inside the monopile could be suctioned out and temporarily stored on a barge to allow access for cutting. Because this sediment removal would occur within the hollow base of the monopile, no listed species would be exposed to effects of this operation. The foundation and transition piece assembly is expected to be cut below the seabed in accordance with the BOEM's removal standards (30 C.F.R. 250.913). The portion of the foundation below the cut will likely remain in place. Depending upon the available crane's capacity, the foundation/transition piece assembly above the cut may be further cut into several more manageable sections to facilitate handling. Then, the cut piece(s) would be lifted out of the water and placed on a barge for transport to an appropriate port area for recycling.

The steel foundations would likely be cut below the mudline using one or a combination of: underwater acetylene cutting torches, mechanical cutting, or a high pressure water jet. The OSS foundation piles will likely be removed according to the same procedures used in the removal of the WTG foundations.

In the BA, BOEM did not provide any estimates of underwater noise associated with pile cutting, and we did not identify any reports of underwater noise monitoring of pile cutting with the proposed methods. Hinzmann et al. (2017) reports on acoustic monitoring of removal of a met-tower monopile associated with the Amrumbank West offshore wind project in the North Sea off the coast of Germany. Internal jet cutting (i.e., the cutter was deployed from inside the monopile) was used to cut the monopile approximately 2.5 m below the mudline. The authors report that the highest sound levels were between 250 and 1,000 Hz. Frequent stopping and starting of the noise suggests that this is an intermittent, rather than continuous noise source. The authors state that values of 160 dB SELcum and 190 dB Peak were not exceeded during the jet cutting process. At a distance of 750 m from the pile, noise attenuated to 150.6 dB rms. For purposes of this consultation, and absent any other information to rely on, we assume that these results are predictive of the underwater noise that can be expected during pile removal during project decommissioning. As such, using these numbers, we would not expect any injury to any listed species because the expected noise levels are below the injury thresholds for whales, sea turtles, and Atlantic sturgeon. We also do not expect any exposure to noise that could result in behavioral disturbance of sea turtles or whales because the noise is below the levels that may result in behavioral disturbance.

Any Atlantic sturgeon within 750 m of the pile being cut would be exposed to underwater noise that is expected to elicit a behavioral response. Exposure to that noise could result in short-term behavioral or physiological responses (e.g., avoidance, stress). Exposure would be brief, just long enough to detect and swim away from the noise, and consequences limited to avoidance of the area within 750 m of the pile during the activity. As such, effects to Atlantic sturgeon will be so small that they cannot be meaningfully measured, evaluated, or detected, and would be insignificant.

The sediments previously removed from the inner space of the pile would be returned to the depression left once the pile is removed. To minimize sediment disturbance and turbidity, a vacuum pump and diver or ROV-assisted hoses would likely be used. This, in combination with the removal of the stones used for scour protection and any concrete mattresses used along the cable route, would reverse the conversion of soft bottom habitat to hard bottom habitat that would occur as a result of project construction. Removal of the foundations would remove the potential for reef effects in the lease area. As we determined that effects of habitat conversion due to construction would be insignificant, we expect the reverse to also be true and would expect that effects of habitat conversion back to pre-construction conditions would also be insignificant.

7.10 Consideration of the Effects of the Action in the Context of Predicted Climate Change due to Past, Present, and Future Activities

Climate change is relevant to the Status of the Species, Environmental Baseline, Effects of the Action, and Cumulative Effects sections of this Opinion. In the Status of the Species section, climate change as it relates to the status of particular species is addressed. Rather than include partial discussion in several sections of this Opinion, we are synthesizing our consideration of the effects of the proposed action in the context of anticipated climate change here[53].

In general, waters in the Mid-Atlantic are warming and are expected to continue to warm over the 35-40-year life of the Atlantic Shores South project (considering construction, operations, and decommissioning). However, waters in the North Atlantic Ocean have warmed more slowly than the global average or slightly cooled. This is because of the Gulf Stream's role in the Atlantic Meridional Overturning Circulation (AMOC). Warm water in the Gulf Stream cools, becomes dense, and sinks, eventually becoming cold, deep waters that travel back equatorward, spilling over features on the ocean floor and mixing with other deep Atlantic waters to form a southward current approximately 1500 m beneath the Gulf Stream (IPCC 2021). Global surface temperatures reached 1.1°C above 1850-1900 levels in 2011-2020 (IPCC 2023) and 0.93°C for ocean temperatures. Globally averaged surface ocean temperatures are projected to increase by approximately 0.7 °C by 2030 and 1.4 °C by 2060 compared to the 1986-2005 average (IPCC 2014), with increases of closer to 2°C predicted for the geographic area that includes the action area. Data from the NOAA weather buoy closest to the lease area (44009) collected from 1984-2008 indicate a mean temperature range from a low of 5°C in the winter to a high of 24°C in the summer, and boat based surveys in the Lease Area had a minimum temperature of 2°C in the winter and a maximum of 26°C in the summer (Atlantic Shores COP 2023). Based on current predictions (IPCC 2014), this could shift to a range of 7.9°C in the winter to 23.8°C in the summer. Global mean sea level increased by 0.20 m between 1901 and 2018; the average rate of sea level rise was 1.3 mm/year between 1901 and 1971, increasing to 1.9 mm /year between 1971 and 2006, and further increasing to 3.7 mm/year between 2006 and 2018 (IPCC 2023). Sea level rise is expected to continue (IPCC 2023) and may affect salt water intrusion into rivers which may affect Atlantic sturgeon. Ocean acidification is also expected to increase over the life of the project (Hare et al. 2016) which may affect the prey of a number of ESA listed species. Ocean acidification is contributing to reduced growth or the decline of zooplankton and other invertebrates that have calcareous shells (Pacific Marine Environmental Laboratory [PMEL] 2020).

We have considered whether it is reasonable to expect ESA listed species whose northern distribution does not currently overlap with the action area to occur in the action area over the project life due to a northward shift in distribution. We have determined that it is not reasonable

[53] The analysis presented here is made in consideration of NMFS Guidance for Treatment of Climate Change in NMFS ESA Decisions (updated 2023); available at: https://www.fisheries.noaa.gov/s3/2023-05/02-110-18-renewal-kdr.pdf

to expect this to occur. This is largely because water temperature is only one factor that influences species distribution. Even with warming waters we do not expect hawksbill sea turtles to occur in the action area because there will still not be any sponge beds or coral reefs that hawksbills depend on and are key to their distribution (NMFS and USFWS 2013). We also do not expect giant manta ray or oceanic whitetip shark to occur in the lease area. Oceanic whitetip shark are a deep-water species (typically greater than 184 m) that occurs beyond the shelf edge on the high seas (Young et al. 2018). Giant manta ray also occur in deeper, offshore waters and occurrence in shallower nearshore waters is coincident with the presence of coral reefs that they rely on for important life history functions (Miller and Klimovich 2017). Smalltooth sawfish do not occur north of Florida. Their life history depends on shallow estuarine habitats fringed with vegetation, usually red mangroves (Norton et al. 2012); such habitat does not occur in the lease area and would not occur even with ocean warming over the course of the proposed action. As such, regardless of the extent of ocean warming that may be reasonably expected in the action area over the life of the project, the habitat will remain inconsistent with habitats used by ESA listed species that currently occur south of the lease area. Therefore, we do not anticipate that any of these species will occur in the lease area over the life of the proposed action.

We have also considered whether climate change will result in changes in the use of the action area by Atlantic sturgeon or the ESA listed turtles and whales considered in this consultation. In a climate vulnerability analysis, Hare et al. (2016) concluded that Atlantic sturgeon are relatively invulnerable to distribution shifts. Given the extensive range of the species along nearly the entire U.S. Atlantic Coast and into Canada, it is unlikely that Atlantic sturgeon would shift out of the action area over the life of the project. If there were shifts in the abundance or distribution of sturgeon prey, it is possible that use of lease area by foraging sturgeon could become more or less common. However, even if the frequency and abundance of use of the lease area by Atlantic sturgeon increased over time, we would not expect any different effects to Atlantic sturgeon than those considered based on the current distribution and abundance of Atlantic sturgeon in the action area.

Use of the action area by sea turtles is driven at least in part by sea surface temperature, with sea turtles absent from the lease area and cable corridors from the late fall through mid-spring due to colder water temperatures. An increase in water temperature could result in an expansion of the time of year that sea turtles are present in the action area and could increase the frequency and abundance of sea turtles in the action area. However, even with a 2°C increase in water temperatures, winter and early spring mean sea surface temperatures in the lease area are still too cold to support sea turtles. Therefore, any expansion in annual temporal distribution in the action area is expected to be small and on the order of days or potentially weeks, but not months. Any changes in distribution of prey would also be expected to affect distribution and abundance of sea turtles and that could be a negative or positive change. It has been speculated that the nesting range of some sea turtle species may shift northward as water temperatures warm. Currently, nesting in the mid-Atlantic is extremely rare. In order for nesting to be successful, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings to survive when they enter the water. Predicted increases in water temperatures over the life of the project are not great enough to allow successful rearing of sea turtle hatchlings in the action area. Therefore, we do not expect that over the time-period considered here, that there would be any nesting activity or hatchlings in the action area. Based on the available information, we expect that any increase in the frequency and abundance of use of the lease area by sea turtles due to increases in mean sea surface temperature would be small. Regardless of this, we would not expect any different effects to sea turtles than those considered based on the current distribution and abundance of sea turtles in the action area. Further, given that any increase in frequency or abundance of sea turtles in the action area is expected to be small we do not expect there to be an increase in risk of vessel strike above what has been considered based on current known distribution and abundance.

The distribution, abundance and migration of baleen whales reflects the distribution, abundance and movements of dense prey patches (e.g., copepods, euphausiids or krill, amphipods, shrimp), which have in turn been linked to oceanographic features affected by climate change (Learmonth et al. 2006). Changes in plankton distribution, abundance, and composition are closely related to ocean climate, including temperature. Changes in conditions may directly alter where foraging occurs by disrupting conditions in areas typically used by species and can result in shifts to areas not traditionally used that have lower quality or lower abundance of prey.

Climate change is unlikely to affect the frequency or abundance of sperm or blue whales in the action area. The species rarity in the lease area is expected to continue over the life of the project due to the depths in the area being shallower than the open ocean deep-water areas typically frequented by sperm whales and their prey. Two of the significant potential prey species for fin whales in the lease area are sand lance and Atlantic herring. Hare et al. (2016) concluded that climate change is likely to negatively impact sand lance and Atlantic herring but noted that there was a high degree of uncertainty in this conclusion. The authors noted that higher temperatures may decrease productivity and limit habitat availability. A reduction in small schooling fish such as sand lance and Atlantic herring in the lease area could result in a decrease in the use of the area by foraging fin whales. The distribution of copepods in the North Atlantic, including in the lease area, is driven by a number of factors that may be impacted by climate change. Record et al. (2019) suggests that recent changes in the distribution of North Atlantic right whales are related to recent rapid changes in climate and prey and notes that while right whales may be able to shift their distribution in response to changing oceanic conditions, the ability to forage successfully in those new habitats is also critically important. Warming in the deep waters of the Gulf of Maine is negatively impacting the abundance of *Calanus finmarchicus*, a primary prey for right whales. *C. finmarchicus* is vulnerable to the effects of global warming, particularly on the Northeast U.S. Shelf, which is in the southern portion of its range (Grieve et al. 2017). Grieve et al. (2017) used models to project *C. finmarchicus* densities into the future under different climate scenarios considering predicted changes in water temperature and salinity. Based on their results, by the 2041–2060 period, 22 – 25% decreases in *C. finmarchicus* density are predicted across all regions of the Northeast U.S. shelf. A decrease in abundance of right whale prey in the WDA could be expected to result in a similar decrease in abundance of right whales in the WDA over the same time scale; however, whether the predicted decline in *C. finmarchicus* density is great enough to result in a decrease in right whale presence in the action area over the life of the project is unknown.

Right whale calving occurs off the coast of the Southeastern U.S. In the final rule designating critical habitat, the following features were identified as essential to successful calving: (1) calm sea surface conditions associated with Force 4 or less on the Beaufort Scale, (2) sea surface temperatures from 7 °C through 17 °C; and, (3) water depths of 6 to 28 meters where these features simultaneously co-occur over contiguous areas of at least 231 km^2 during the months of November through April. Even with a 2°C shift in mean sea surface temperature, waters off New Jersey in the November to April period will not be warm enough to support calving. While there could be a northward shift in calving over this period, it is not reasonable to expect that over the life of the project that calving would occur in the WDA. Further, given the thermal tolerances of young calves (Garrison 2007) we do not expect that the distribution of young calves would shift northward into the action area such that there would be more or younger calves in the action area.

Based on the available information, it is difficult to predict how the use of the action area by large whales may change over the operational life of the project. However, we do not expect changes in use by sperm or blue whales. Changes in habitat used by sei, fin, and right whales may be related to a northward shift in distribution due to warming waters and a decreased abundance of prey. However, it is also possible that reductions in prey in other areas, including the Gulf of Maine, result in persistence of foraging in the WDA over time. Based on the information available at this time, it seems most likely that the use of the WDA by large whales will decrease or remain stable. As such, we do not expect any changes in abundance or distribution that would result in different effects of the action than those considered in the Effects of the Action section of this Opinion. To the extent new information on climate change, listed species, and their prey becomes available in the future, reinitiation of this consultation may be necessary.

8.0 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 C.F.R. §402.02). Future Federal actions that are not consequences of the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. It is important to note that, while there may be some overlap, the ESA definition of cumulative effects is not equivalent to the definition of "cumulative impacts" as described in the Atlantic Shores South DEIS. Under NEPA, "cumulative effects…are the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. While the effects of past and ongoing Federal projects within the action area for which consultation has been completed are evaluated in both the NEPA and ESA processes (Section 6.0 *Environmental Baseline*), reasonably foreseeable future actions by federal agencies must be considered (see 40 CFR 1508.7) in the NEPA process but not the ESA Section 7 process.

We reviewed the list of past, ongoing and planned actions identified by BOEM in the DEIS and determined that most (other offshore wind energy development activities; undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; Federal fisheries use, management, and monitoring surveys, and, oil and gas activities) do not meet the ESA definition of cumulative effects because we expect that if any of these activities were proposed in the action area, or proposed elsewhere yet were to have future effects inside the action area, they would require at least one Federal authorization or permit and would therefore require their own ESA section 7 consultation. BOEM identifies global climate change as a cumulative impact in the DEIS. Because global climate change is not a future state or private activity, we do not consider it a cumulative effect for the purposes of this consultation. Rather, future state or private activities reasonably certain to occur and contribute to climate change's effects in the action area are relevant. However, given the difficulty of parsing out climate change effects due to past and present activities from those of future state and private activities, we discussed the effects of the action in the context of climate change due to past, present, and future activities in the Effects of the Action section above. The remaining cumulative impacts identified in the DEIS (marine transportation, coastal development, and state and private fisheries use and management) are addressed below.

It is important to note that because any future offshore wind project will require section 7 consultation, these future wind projects do not fit within the ESA definition of cumulative effects and none of them are considered in this Opinion. However, in each successive consultation, the effects on listed species of other offshore wind projects under construction or completed would be considered to the extent they influence the status of the species and/or environmental baseline according to the best available scientific information. We have presented information on the South Fork, Vineyard Wind 1, Ocean Wind, CVOW, Empire Wind, Sunrise Wind, and Revolution Wind projects in the *Environmental Baseline* of this Opinion to provide context for the effects of approved offshore wind projects in general and specifically those activities that are affecting listed species that occur in the action area.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area or have effects in the action area. We did not find any information about non-Federal actions other than what has already been described in the *Environmental Baseline*. The primary non-Federal activities that will continue to have effects in the action area are: Recreational fisheries, fisheries authorized by states, use of the action area by private vessels, discharge of wastewater and associated pollutants, and coastal development authorized by state and local governments. Any coastal development that requires a Federal authorization, inclusive of a permit from the USACE, would require future section 7 consultation and the effects of permit issuance would not be considered a cumulative effect. We do not have any information to indicate that effects of these activities over the life of the proposed action will have different effects than those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

The *Integration and Synthesis* section is the final step in our assessment of the effects and corresponding risk posed to ESA-listed species and designated critical habitat affected as a result of implementing the proposed action. In Section 4, we determined that the project will have no effect on oceanic whitetip sharks, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, any species of ESA listed corals and will have no effect on critical habitat designated for the North Atlantic right whale, the Northwest

Atlantic DPS of loggerhead sea turtles, or elkhorn or staghorn corals. We concluded that the proposed action was not likely to adversely affect blue whales, Rice's whales, giant manta rays, hawksbill sea turtles, gulf sturgeon, and oceanic whitetip sharks. Those species and critical habitat for which we reached a "not likely to adversely affect" conclusion are addressed in section 4 of this Opinion.

In this section, we add the *Effects of the Action* (Section 7) to the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), while also considering effects in context of climate change and the S*tatus of the Species* (Section 5), to formulate the agency's biological opinion as to whether the proposed action "reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing its numbers, reproduction, or distribution" (50 CFR §402.02; the definition of "jeopardize the continued existence of" an ESA-listed species). The purpose of this analysis in this Opinion is to determine whether the proposed action is likely to jeopardize the continued existence of North Atlantic right, fin, sei, or sperm whales, five DPSs of Atlantic sturgeon, shortnose sturgeon, the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, or leatherback or Kemp's ridley sea turtles. As noted below, we have determined that there will be no effects to critical habitat designated for the New York Bight DPS of Atlantic sturgeon beyond those effects included in the Environmental Baseline.

Below, for the listed species that may be adversely affected by the proposed action (i.e., those species affected by the action and for which *all* effects are not extremely unlikely (discountable) and/or insignificant) we summarize the status of the species and consider whether the action will result in reductions in reproduction, numbers, or distribution of these species. We then consider whether any reductions in reproduction, numbers, or distribution resulting from the action would reduce appreciably the likelihood of both the survival and recovery of these species, consistent with the definition of "jeopardize the existence of" (50 C.F.R. §402.02) for purposes Sections 7(a)(2) and 7(b)of the federal Endangered Species Act and its implementing regulations.

In addition, we use the following guidance and regulatory definitions related to survival and recovery to guide our jeopardy analysis. In the NMFS/USFWS Section 7 Consultation Handbook (1998), for the purposes of determining whether jeopardy is likely, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined in regulation as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 50 C.F.R. §402.02

9.1 Shortnose Sturgeon

The only portions of the action area that overlap with the distribution of shortnose sturgeon are the Delaware River where vessels transiting to/from the Paulsboro Marine Terminal, Repauno Terminal, and New Jersey Wind Port will travel.

NMFS completed ESA consultation on the construction and operation of the Paulsboro facility in November 2023 (the Opinion was a result of reinitiation and replaced the July 2022 Paulsboro Opinion); in the November 2023 Opinion, we considered effects of all vessels using the Paulsboro Marine Terminal over a 10-year period and the risk of vessel strike to shortnose sturgeon from those vessel operations. In the November 2023 Opinion, NMFS concluded that vessel operations associated with the terminal were likely to adversely affect, but not likely to jeopardize the continued existence of shortnose sturgeon. In this Opinion, we identify the portion of the take (i.e., lethal vessel strike) identified in the Paulsboro Opinion that would be attributable to the Atlantic Shores vessels. As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to Paulsboro identified in BOEM's BA, we have determined that Atlantic Shores' vessels utilizing the Paulsboro Marine Terminal will strike and kill up to one shortnose sturgeon while transiting the Delaware River. The effects of these vessel trips are included in the *Environmental Baseline* for the Atlantic Shores project.

NMFS completed ESA consultation on the construction and operation of the NJWP in February 2022; in the February 2022 Opinion, we considered effects of all vessels using the NJWP over a 25-year period and the risk of vessel strike to shortnose sturgeon from those vessel operations. In the February 2022 Opinion, NMFS concluded that the vessel operations associated with NJWP were likely to adversely affect, but not likely to jeopardize the continued existence of shortnose sturgeon. In this Opinion, we identify the portion of the take (i.e., lethal vessel strike) identified in the NJWP Opinion that would be attributable to the Atlantic Shores vessels. As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to NJWP identified in BOEM's BA, we have determined that Atlantic Shores' vessels utilizing the NJWP will strike and kill up to one shortnose sturgeon while transiting the Delaware River. The effects of these vessel trips are included in the *Environmental Baseline* for the Atlantic Shores project.

NMFS completed ESA consultation on the construction and operation of the Repauno Terminal in December 2017; in the December 2017 Opinion, we considered effects of all vessels using these ports over a 30-year period and the risk of vessel strike to shortnose sturgeon from those vessel operations. In the December 2017 Opinion, NMFS concluded that the proposed actions were likely to adversely affect, but not likely to jeopardize the continued existence of shortnose sturgeon. In this Opinion, we identify the portion of the take (i.e., lethal vessel strike) identified in the NJWP Opinion that would be attributable to the Atlantic Shores vessels. As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to Repauno identified in BOEM's BA, we have determined that Atlantic Shores' vessels utilizing the Repauno Terminal are extremely unlikely to strike any shortnose sturgeon while transiting the Delaware River. The effects of these vessel trips are included in the *Environmental Baseline* for the Atlantic Shores project.

We have not identified any effects of the Atlantic Shores project on shortnose sturgeon that are beyond (i.e. different or in addition to) what was considered in the three consultations addressed above. As such, consistent with the conclusions of the Paulsboro, NJWP, and Repauno consultations we have determined that the proposed actions considered here are likely to adversely affect (for vessel transits to Paulsboro and NJP) but not likely to jeopardize the continued existence of shortnose sturgeon (for vessel transits to Paulsboro, NJP and Repauno).

9.2 Critical Habitat Designated for the New York Bight DPS of Atlantic Sturgeon

The critical habitat designation for the New York Bight DPS is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The Delaware River critical habitat unit extends from the Trenton-Morrisville Route 1 Toll Bridge at approximately RKM 213.5, downstream to where the main stem river discharges into Delaware Bay at approximately RKM 78. The action area overlaps with a portion of the Delaware River critical habitat unit designated for the New York Bight DPS. The only project activity that may affect this critical habitat is the transit of project vessels to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately RKM 139), Repauno, and the New Jersey Wind Port in Hope Creek, NJ (approximately RKM 84).

The Biological Opinions prepared by NMFS for the Paulsboro, Repauno, and New Jersey Wind Port considered effects of construction of these port facilities and the effects of anticipated vessel calls to the respective port on critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon; the same conclusion was reached in NMFS December 8, 2017 Biological Opinion for the Repauno Terminal. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. As explained in sections 6 and 7 of this Opinion, we are not able to determine the proportional effects of Atlantic Shores' vessel use of these port facilities on critical habitat, but we determined it is within the scope of effects considered in the respective Opinions. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the Environmental Baseline for the Atlantic Shores project. We have not identified any effects of the Atlantic Shores project that are beyond what was considered in the Paulsboro, Repauno, and New Jersey Wind Port consultations. As such, consistent with the conclusions of the New Jersey Wind Port consultation we have determined that the proposed actions considered here, and specifically the use of the NJWP by Atlantic Shores vessels, are likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon.

9.3 Atlantic sturgeon

In the *Effects of the Action* section above, we determined that 2 Gulf of Maine, 46 New York Bight, 19 Chesapeake Bay, 11 South Atlantic, and 5 Carolina DPS Atlantic sturgeon are likely to be captured and released alive with only minor, recoverable injuries during the approximately 7 year period that the trawl surveys take place. While exposure to pile driving noise may result in a behavioral response from individuals close enough to the noise source to be disturbed, we determined that effects of that noise exposure will be insignificant; no take of any type including harm, harassment, injury, or mortality is expected to result from exposure to project noise. We determined that all effects to habitat and prey would be insignificant or extremely unlikely to occur. All effects of project operations, including operational noise and the physical presence of the turbine foundations and electric cables, and effects to Atlantic sturgeon from changes to ecological conditions are extremely unlikely to occur or insignificant.

As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to the Paulsboro Marine Terminal identified in BOEM's BA, we have determined that Atlantic Shores' vessels utilizing the Paulsboro Marine Terminal will strike and kill up to two New York Bight DPS Atlantic sturgeon while transiting the Delaware River. We also expect that vessel transiting to/from the NJWP will strike and kill up to two New York Bight DPS Atlantic sturgeon and 1 Atlantic sturgeon from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS. Vessels traveling to/from the Repauno Terminal are expected to strike and kill up to one New York Bight DPS Atlantic sturgeon. The effects of these vessel trips and the loss of these individuals from their respective DPS is included in the *Environmental Baseline* for this Opinion. No other strikes of Atlantic sturgeon from any DPS are anticipated as a result of any other project vessel traffic, inclusive of consideration of vessel traffic in the entrance to the Chesapeake Bay for trips to/from Portsmouth, VA.

9.3.1 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS is listed as threatened. While Atlantic sturgeon occur in several rivers in the Gulf of Maine DPS, recent spawning has only been documented in the Kennebec River. There are no abundance estimates for the Gulf of Maine DPS as a whole. The estimated effective population size of the Kennebec River is less than 70 adults, which suggests a relatively small spawning population (NMFS 2022). NMFS estimated adult and subadult abundance of the Gulf of Maine DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013) and concluded that subadult and adult abundance of the Gulf of Maine DPS was 7,455 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016).

Gulf of Maine origin Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole. The ASMFC stock assessment concluded that the abundance of the Gulf of Maine DPS is "depleted" relative to historical levels. The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. The assessment concluded that there is a 51 percent probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The Commission also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). However, the Commission noted that there was considerable uncertainty related to these numbers, particularly concerning trends data for the Gulf of Maine DPS. For example, the stock assessment notes that it was not clear if: (1) the percent probability for the trend in abundance for the Gulf of Maine DPS is a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

As described in the 5-Year Review for the Gulf of Maine DPS (NMFS 2022), the demographic risk for the DPS is "moderate"[54] because of its low productivity (i.e., relatively few adults compared to historical levels), low abundance (i.e., only one known spawning population and low DPS abundance, overall), and limited spatial distribution (i.e., limited spawning habitat within the one river known to support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

The effects of the proposed Atlantic Shores project are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Atlantic Shores project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the *Environmental Baseline* and in consideration of *Cumulative Effects* and climate change. With the exception of effects of vessel traffic in the Delaware River from Atlantic Shores vessels transiting to the New Jersey Wind Port, which is expected to result in the mortality of up to 1 GOM DPS Atlantic sturgeon, which is included in the Environmental Baseline, the only adverse effects of the proposed action on GOM DPS Atlantic sturgeon are the non-lethal capture (and release) of 2 Gulf of Maine DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of Atlantic sturgeon in the action area. All effects to Atlantic sturgeon from impacts to habitat and prey will be insignificant.

Live sturgeon captured and released in the trawl survey may experience minor injuries (i.e., scrapes, abrasions); however, they are expected to make a complete recovery without any impairment to future fitness. Capture will temporarily prevent these individuals from carrying

[54] 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the sturgeon are returned to the water; for trawls the length of capture will be no more than the 20 minute tow time plus a short handling period on board the vessel. The capture of live sturgeon will not reduce the numbers of Atlantic sturgeon in the action area or the numbers of Gulf of Maine DPS Atlantic sturgeon as a whole. Similarly, as the capture of live Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live Atlantic sturgeon is also not likely to affect the distribution of Atlantic sturgeon in the action area or affect the distribution of Atlantic sturgeon throughout their range. As any effects to individual live Atlantic sturgeon removed from the trawl gear will be minor and temporary without any mortality or effects on reproduction, we do not anticipate any population level impacts.

The proposed project will not result in the mortality of any Gulf of Maine DPS Atlantic sturgeon beyond what is considered in the Environmental Baseline (inclusive of the mortality of up to one GOM DPS Atlantic sturgeon resulting from Atlantic Shores' vessel traffic in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of one individual already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede Gulf of Maine DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Gulf of Maine DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Gulf of Maine DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated reduction in the potential future reproduction; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Gulf of Maine DPS Atlantic sturgeon in the action area and no consequence on the distribution of the DPS throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Gulf of Maine DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Gulf of Maine DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Gulf of Maine DPS Atlantic sturgeon can rebuild to a point where the Gulf of Maine DPS of Atlantic sturgeon is no longer likely to become an endangered or threatened species within the foreseeable future throughout all or a significant portion of its range.

No Recovery Plan for the Gulf of Maine DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018[55]). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Gulf of Maine DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Gulf of Maine DPS likelihood of recovery.

This action will not change the status or trend of the Gulf of Maine DPS. The proposed action will not affect the distribution of Atlantic sturgeon Gulf of Maine DPS across the historical range. The proposed action will not result in mortality or reduction in future reproductive output and will not impair the species' resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Gulf of Maine DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Gulf of Maine DPS of

[55] Available online at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed December 1, 2023

Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Gulf of Maine DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Gulf of Maine DPS of Atlantic sturgeon. These conclusions were made in consideration of the threatened status of the Gulf of Maine DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.2 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the New York Bight, recent spawning has only been documented in the Hudson and Delaware rivers. The essential physical features necessary to support spawning and recruitment are also present in the Connecticut and Housatonic Rivers (82 FR 39160; August 17, 2017). However, there is no current evidence that spawning is occurring nor are there studies underway to investigate spawning occurrence in those rivers; except one recent study where young of year (YOY) fish of were captured in the Connecticut River (Savoy *et al.* 2017). Genetic analysis suggests that the YOY belonged to the South Atlantic DPS and at this time, we do not know if these fish were the result of a single spawning event due to unique straying of the adults from the South Atlantic DPS's spawning rivers. NMFS estimated adult and subadult abundance of the New York Bight DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013) and concluded that subadult and adult abundance of the New York Bight DPS was 34,566 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016).
The 2017 ASMFC stock assessment determined that abundance of the New York Bight DPS is "depleted" relative to historical levels (ASMFC 2017). The assessment also determined there is a relatively high probability (75 percent) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31 percent probability that mortality for the New York Bight DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). The Commission noted, however, there is significant uncertainty in relation to the trend data. Moreover, new information suggests that the Commission's conclusions primarily reflect the status and trend of only the DPS's Hudson River spawning population.

New York Bight DPS origin Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. The largest single source of mortality appears to be capture as bycatch in commercial fisheries operating in the marine environment. Because early life stages and juveniles do not leave the river, they are not impacted by fisheries occurring in federal waters. Bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (the shad fishery) has now been closed and there is no indication that it will reopen soon. New York Bight DPS Atlantic sturgeon are killed as a result of other anthropogenic activities in the Hudson, Delaware, and other rivers within the New York Bight as well; sources of potential mortality include vessel strikes and entrainment in dredges.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of New York Bight DPS Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Atlantic Shores project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the Environmental Baseline and in consideration of Cumulative Effects and climate change. Outside of the anticipated lethal vessel strike of up to 5 New York Bight DPS Atlantic sturgeon from Atlantic Shores vessels transiting within the Delaware River to/from the Paulsboro Marine Terminal, NJWP, and/or Repauno, the only adverse effects of the proposed action on Atlantic sturgeon New York Bight DPS are the non-lethal capture (and release) of 46 New York Bight DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any New York Bight DPS Atlantic sturgeon to be struck by any project vessels beyond the 5 strikes anticipated in the Delaware River/Delaware Bay addressed in the Environmental Baseline. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of New York Bight DPS Atlantic sturgeon in the action area. All effects to Atlantic sturgeon New York Bight DPS from impacts to habitat and prey will be insignificant.

Live sturgeon captured and released in the trawl survey may experience minor injuries (i.e., scrapes, abrasions); however, they are expected to make a complete recovery without any impairment to future fitness. Capture will temporarily prevent these individuals from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the sturgeon are returned to the water; for trawls the length of capture will be no more than the 20 minute tow time plus a short handling period on board the vessel. The capture of live sturgeon will not reduce the numbers of Atlantic sturgeon from the New York Bight DPS in the action area or the numbers of New York Bight DPS Atlantic sturgeon as a whole. Similarly, as the capture of live Atlantic sturgeon from the New York Bight DPS will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live Atlantic sturgeon is also not likely to affect the distribution of Atlantic sturgeon from the New York Bight DPS in the action area or affect the distribution of Atlantic sturgeon the DPS throughout its range. As any effects to individual live New York Bight DPS Atlantic sturgeon removed from the trawl gear will be minor and temporary without any mortality or effects on reproduction, we do not anticipate any population level impacts.

The proposed project will not result in the mortality of any Atlantic sturgeon beyond what is considered in the Environmental Baseline (inclusive of the mortality of up to five New York Bight DPS Atlantic sturgeon resulting from Atlantic Shores' vessel traffic in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of one individual already addressed in the Baseline. The proposed action is not likely to reduce distribution because the action will not impede New York Bight DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the New York Bight DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction beyond what has been accounted for in the Environmental Baseline (death and loss of future reproductive potential of no more than 5 subadult or adult New York Bight DPS Atlantic sturgeon, which represents an extremely small percentage of the DPS); (2) the proposed action will not change the status or trends of the New York Bight DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of New York Bight DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering New York Bight DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the New York Bight DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that New York Bight DPS Atlantic sturgeon can rebuild to a point where listing of the New York Bight DPS of Atlantic sturgeon as endangered or threatened is no longer appropriate.

No Recovery Plan for the New York Bight DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For New York Bight DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the New York Bight DPS likelihood of recovery.

This action will not change the status or trend of the New York Bight DPS. The proposed action will not affect the distribution of Atlantic sturgeon across the historical range. The proposed action will not result in mortality or reduction in future reproductive output beyond what was considered in the Environmental Baseline and will not impair the species' resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the New York Bight DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the New York Bight DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of the New York Bight DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the New York Bight DPS of Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the New York Bight DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the Chesapeake Bay DPS, at the time of listing spawning was only known to occur in the James River. Since the listing, there is evidence of additional spawning populations in the Chesapeake Bay DPS, including the Pamunkey River, a tributary of the York River, and in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al. 2014, Kahn et al. 2014, Richardson and Secor 2016, Secor et al. 2021). Detections of acoustically-tagged adult Atlantic sturgeon along with historical evidence suggests that Atlantic sturgeon belonging to the Chesapeake Bay DPS may be spawning in the Mattaponi and Rappahannock rivers as well (Hilton et al. 2016, ASMFC 2017, Kahn et al. 2019). However, information for these populations is limited and the research is ongoing.

Chesapeake Bay DPS Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently no census nor enough information to establish a trend, for any life stage, for the James River spawning population, or for the DPS as a whole. However, the NEAMAP data indicates that the estimated ocean population of Chesapeake Bay DPS Atlantic sturgeon is 8,811 sub-adult and adult individuals (2,203 adults and 6,608 subadults). The ASMFC (2017) stock assessment determined that abundance of the Chesapeake Bay DPS is "depleted" relative to historical levels. The assessment, while noting significant uncertainty in trend data, also determined that there is a relatively low probability (36 percent) that abundance of the Chesapeake Bay DPS has increased since the implementation of the 1998 fishing moratorium, and a 30 percent probability that mortality for the Chesapeake Bay DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

As described in the 5-Year Review for the Chesapeake Bay DPS (NMFS 2022), the demographic risk for the DPS is "High" because of its low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only three known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g. limited spawning habitat within each of the few known rivers that support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Atlantic Shores project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the Environmental Baseline and in consideration of Cumulative Effects and climate change. With the exception of effects of vessel traffic in the Delaware River from Atlantic Shores vessels transiting to the New Jersey Wind Port, which are expected to result in the mortality of up to 1 Chesapeake Bay DPS Atlantic Sturgeon are is included in the Environmental Baseline, the only adverse effects of the proposed action on Atlantic sturgeon are the non-lethal capture of 19 Chesapeake Bay DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any Chesapeake Bay DPS Atlantic sturgeon to be struck by any project vessels outside of the Delaware River. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of Chesapeake Bay DPS Atlantic sturgeon in the action area. All effects to Chesapeake Bay DPS Atlantic sturgeon from impacts to habitat and prey will be insignificant.

Live sturgeon captured and released in the trawl survey may experience minor injuries (i.e., scrapes, abrasions); however, they are expected to make a complete recovery without any impairment to future fitness. Capture will temporarily prevent these individuals from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the sturgeon are returned to the water; for trawls the length of capture will be no more than the 20 minute tow time plus a short handling period on board the vessel. The capture of live sturgeon will not reduce the numbers of Atlantic sturgeon in the action area or the numbers of Chesapeake Bay DPS Atlantic sturgeon as a whole. Similarly, as the capture of live Atlantic sturgeon will not affect the fitness of any individual: no effects to reproduction are anticipated. The capture of live Atlantic sturgeon from the Chesapeake Bay DPS is also not likely to affect the distribution of the DPS in the action area or affect the distribution of the DPS throughout its range. As any effects to individual live Chesapeake Bay DPS Atlantic sturgeon removed from the trawl gear will be minor and temporary without any mortality or effects on reproduction, we do not anticipate any population level impacts.

The proposed project will not result in the mortality of any Atlantic sturgeon beyond what is considered in the Environmental Baseline (inclusive of the mortality of no more than one Chesapeake Bay DPS Atlantic sturgeon resulting from Atlantic Shores' vessel traffic in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of one individual already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede Chesapeake Bay DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Chesapeake Bay DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Chesapeake Bay DPS

Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Chesapeake Bay DPS Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction; (2) the proposed action will not change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Chesapeake Bay DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Chesapeake Bay DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Chesapeake Bay DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Chesapeake Bay DPS Atlantic sturgeon can rebuild to a point where listing of the Chesapeake Bay DPS of Atlantic sturgeon as threatened or endangered is no longer appropriate.

No Recovery Plan for the Chesapeake Bay DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Chesapeake Bay DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Chesapeake Bay DPS likelihood of recovery.

This action will not change the status or trend of the Chesapeake Bay DPS. The proposed action will not affect the distribution of Chesapeake Bay DPS Atlantic sturgeon across its historical range. The proposed action will not result in mortality or reduction in future reproductive output beyond what was considered in the Environmental Baseline and will not impair the DPS's resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Chesapeake Bay DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Chesapeake Bay DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Chesapeake Bay DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Chesapeake Bay DPS of Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the Chesapeake Bay DPS of Atlantic sturgeon, the effects of the action other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.4 Carolina DPS of Atlantic sturgeon

The Carolina DPS is listed as endangered. Atlantic sturgeon from the Carolina DPS spawn in the rivers of North Carolina south to the Cooper River, South Carolina. There are currently seven spawning subpopulations within the Carolina DPS: Roanoke River, Tar-Pamlico River, Neuse River, Northeast Cape Fear and Cape Fear Rivers, Waccamaw and Great Pee Dee Rivers, Black River, Santee and Cooper Rivers. NMFS estimated adult and subadult abundance of the Carolina DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013) and concluded that subadult and adult abundance of the Carolina DPS was 1,356 sturgeon (339 adults and 1,017 subadults) (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as two years old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012; Hilton et al. 2016).

Very few data sets are available that cover the full potential life span of an Atlantic sturgeon. The ASMFC concluded for the Stock Assessment that it could not estimate abundance of the Carolina DPS or otherwise quantify the trend in abundance because of the limited available information. However, the Stock Assessment was a comprehensive review of the available information, and used multiple methods and analyses to assess the status of the Carolina DPS and the coast wide stock of Atlantic sturgeon. For example, the Stock Assessment Subcommittee defined a benchmark, the mortality threshold, against which mortality for the coast wide stock of Atlantic sturgeon as well as for each DPS were compared[56] to assess whether the current mortality experienced by the coast wide stock and each DPS is greater than what it can sustain. This information informs the current trend of the Carolina DPS.

In the Stock Assessment, the ASMFC concluded that abundance of the Carolina DPS is "depleted" relative to historical levels and there is a relatively low probability (36 percent) that abundance of the Carolina DPS has increased since the implementation of the 1998 fishing moratorium. The ASMFC also concluded that there is a relatively low likelihood (25 percent probability) that mortality for the Carolina DPS does not exceed the mortality threshold used for the Stock Assessment (ASMFC 2017).

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline*, may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Atlantic Shores project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the *Environmental Baseline* and in consideration of *Cumulative Effects* and climate change. The only adverse effects of the proposed action on Carolina DPS Atlantic sturgeon are the non-lethal capture of 5 Carolina DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any Carolina DPS Atlantic sturgeon to be struck by any project vessels. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of the Carolina DPS Atlantic sturgeon in the action area. All effects to the Carolina DPS Atlantic sturgeon from impacts to habitat and prey will be insignificant.

Live sturgeon captured and released in the trawl survey may experience minor injuries (i.e., scrapes, abrasions); however, they are expected to make a complete recovery without any impairment to future fitness. Capture will temporarily prevent these individuals from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected

[56] The analysis considered both a coast wide mortality threshold and a region-specific mortality threshold to evaluate the sensitivity of the model to differences in life history parameters among the different DPSs (e.g., Atlantic sturgeon in the northern region are slower growing, longer lived; Atlantic sturgeon in the southern region are faster growing, shorter lived).

to resume as soon as the sturgeon are returned to the water; for trawls the length of capture will be no more than the 20 minute tow time plus a short handling period on board the vessel. The capture of live sturgeon will not reduce the numbers of the Carolina DPS Atlantic sturgeon in the action area or the numbers of Carolina DPS Atlantic sturgeon as a whole. Similarly, as the capture of live Carolina DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live Carolina DPS Atlantic sturgeon is also not likely to affect the distribution of Atlantic sturgeon in the action area or affect the distribution of the DPS sturgeon throughout its range. As any effects to individual live Carolina DPS Atlantic sturgeon removed from the trawl gear will be minor and temporary without any mortality or effects on reproduction, we do not anticipate any population level impacts.

The proposed project will not result in the mortality of any Carolina DPS Atlantic sturgeon. There will be no effects on reproduction of any Carolina DPS Atlantic sturgeon. The proposed action is not likely to reduce distribution, because the action will not impede Carolina DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Carolina DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Carolina DPS Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, migrating and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Carolina DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Carolina DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Carolina DPS Atlantic sturgeon can rebuild to a point where the Carolina DPS of

Atlantic sturgeon is no longer likely to become an endangered or threatened species within the foreseeable future throughout all or a significant portion of its range.

No Recovery Plan for the Carolina DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Carolina DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Carolina DPS likelihood of recovery.

This action will not change the status or trend of the Carolina DPS. The proposed action will not affect the distribution of the Carolina DPS Atlantic sturgeon across the historical range. The proposed action will not result in mortality or reduction in future reproductive output of the Carolina DPS and will not impair the DPS's resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Carolina DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon can be brought to the point at which listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Carolina DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Carolina DPS of

Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the Carolina DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects,* and any anticipated effects of climate change.

9.3.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS Atlantic sturgeon is listed as endangered and Atlantic sturgeon originate from at least six rivers where spawning potentially still occurs. Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. In Georgia, prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in Georgia prior to 1890. At the time of listing, only six spawning subpopulations were thought to have existed in the South Atlantic DPS: Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River (including the Oconee and Ocmulgee tributaries), and the Satilla River. Three of the spawning subpopulations in the South Atlantic DPS are relatively robust and are considered the second (Altamaha River) and third (Combahee/Edisto River) largest spawning subpopulations across all five DPSs. Peterson *et al.* (2008) estimated the number of spawning adults in the Altamaha River was 324 (95 percent CI: 143-667) in 2004 and 386 (95 percent CI: 216-787) in 2005. Bahr and Peterson (2016) estimated the age-1 juvenile abundance in the Savannah River from 2013-2015 at 528 in 2013, 589 in 2014, and 597 in 2015. No census of the number of Atlantic sturgeon in any of the other spawning rivers or for the DPS as a whole is available. However, the NEAMAP data indicates that the estimated ocean population of South Atlantic DPS Atlantic sturgeon sub-adults and adults is 14,911 individuals (3,728 adults and 11,183 subadults).

The 2017 ASMFC stock assessment determined that abundance of the South Atlantic DPS is “depleted” relative to historical levels (ASMFC 2017). Due to a lack of suitable indices, the assessment was unable to determine the probability that the abundance of the South Atlantic DPS has increased since the implementation of the 1998 fishing moratorium. However, it was estimated that there is a 40 percent probability that mortality for the South Atlantic DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). We note that the Commission expressed significant uncertainty in relation to the trends data.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline*, may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Atlantic Shores project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the Environmental Baseline and in consideration of Cumulative Effects and climate change. With the exception of effects of vessel traffic in the Delaware River from Atlantic Shores vessels transiting to the New Jersey Wind Port, resulting in the mortality of no more than one South Atlantic DPS Atlantic sturgeon, which is included in the Environmental Baseline, the only adverse effects of the proposed action on South Atlantic DPS Atlantic sturgeon are the non-lethal capture of 11 South Atlantic DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any South Atlantic DPS Atlantic sturgeon to be struck by any project vessels. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of South Atlantic DPS Atlantic sturgeon in the action area. All effects to South Atlantic DPS Atlantic sturgeon from impacts to habitat and prey will be insignificant.

Live sturgeon captured and released in the trawl survey may experience minor injuries (i.e., scrapes, abrasions); however, they are expected to make a complete recovery without any impairment to future fitness. Capture will temporarily prevent these individuals from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the sturgeon are returned to the water; for trawls the length of capture will be no more than the 20 minute tow time plus a short handling period on board the vessel. The capture of live sturgeon will not reduce the numbers of Atlantic sturgeon in the action area or the numbers of South Atlantic DPS Atlantic sturgeon as a whole. Similarly, as the capture of live South Atlantic DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live South Atlantic DPS Atlantic sturgeon is also not likely to affect the distribution of the DPS in the action area or affect the distribution of South Atlantic DPS Atlantic sturgeon throughout their range. As any effects to individual live South Atlantic DPS Atlantic sturgeon removed from the trawl gear will be minor and temporary without any mortality or effects on reproduction, we do not anticipate any population level impacts.

The proposed project will not result in the mortality of any Atlantic sturgeon beyond what is considered in the Environmental Baseline (inclusive of the mortality of no more than one South Atlantic DPS Atlantic sturgeon resulting from Atlantic Shores' vessel traffic in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of one individual already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede South Atlantic DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the South Atlantic DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the South Atlantic DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of South Atlantic DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering South Atlantic DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the South Atlantic DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that South Atlantic DPS Atlantic sturgeon can rebuild to a point where the South Atlantic DPS of Atlantic sturgeon is no longer likely to become an endangered or threated species within the foreseeable future throughout all or a significant portion of its range.

No Recovery Plan for the South Atlantic DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migration, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For South Atlantic DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the South Atlantic DPS likelihood of recovery.

This action will not change the status or trend of the South Atlantic DPS. The proposed action will not affect the distribution of South Atlantic DPS Atlantic sturgeon across the historical range. The proposed action will not result in mortality or reduction in future reproductive output beyond what was considered in the *Environmental Baseline* and will not impair the DPS's resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the South Atlantic DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the South Atlantic DPS of Atlantic sturgeon can be brought to the point at which listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the South Atlantic DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the South Atlantic DPS of Atlantic sturgeon. These conclusions were made in consideration of the status of the South Atlantic DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.4 Sea Turtles

Our effects analysis determined that impact pile driving noise is likely to adversely affect a number of individual ESA-listed sea turtles in the action area and cause temporary threshold shift, behavioral response, and stress (meeting the definition of harassment in the context of ESA take) but that no PTS, serious injury, or mortality is anticipated. We determined that impacts to hearing (TTS, and masking) and avoidance behavior would not increase the risk of vessel strike or entanglement or capture in fishing gear. While this biological opinion relies on the best available scientific and commercial information, our analysis and conclusions include uncertainty about the basic hearing capabilities of sea turtles, such as how they use sound to perceive and respond to environmental cues, and how temporary changes to their acoustic soundscape could affect the normal physiology and behavioral ecology of these species. We determined that exposure to other project noise, including HRG surveys and operational noise will have effects that are insignificant or discountable. We expect that project vessels will strike and kill no more than 2 leatherback, 21 NWA DPS loggerhead, 2 NA DPS green, and 3 Kemp's ridley sea turtle over the 40-year life of the project, inclusive of the construction, operation, and decommissioning period. We expect that 7 NWA DPS loggerhead, 1 NA DPS green, and 5

Kemp's ridley sea turtles will be captured in the trawl surveys and be released alive. We do not expect the entanglement or capture of any sea turtles in any other fisheries surveys. We also determined that effects to habitat and prey are insignificant or discountable. In this section, we discuss the likely consequences of these effects to individual sea turtles, the populations those individuals represent, and the species/DPS those populations comprise.

In this section we assess the likely consequences of these effects to the sea turtles that have been exposed, the populations those individuals represent, and the species/DPS those populations comprise. Section 5.2 described current sea turtle population statuses and the threats to their survival and recovery. Most sea turtle populations have undergone significant to severe reduction by human harvesting of both eggs and sea turtles, loss of beach nesting habitats, as well as severe bycatch pressure in worldwide fishing industries. The *Environmental Baseline* identified actions expected to generally continue for the foreseeable future for each of these species of sea turtle that may affect sea turtles in the action area. As described in section 7.10, climate change may result in a northward distribution of sea turtles, which could result in a small change in the abundance, and seasonal distribution of sea turtles in the action area over the 40-year life of the Atlantic Shores project. However, as described there, given the cool winter water temperatures in the action area and considering the amount of warming that is anticipated, any shift in seasonal distribution is expected to be small (potential additional weeks per year, not months) and any increase in abundance in the action area is expected to be small. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change.

9.4.1 Northwest Atlantic DPS of Loggerhead Sea Turtles

The Northwest Atlantic DPS of loggerhead sea turtles is listed as threatened. Based on nesting data and population abundance and trends at the time, NMFS and USFWS determined in 2011 that the Northwest Atlantic DPS should be listed as threatened and not endangered based on: (1) the large size of the nesting population, (2) the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and (4) substantial conservation efforts are underway to address threats (76 FR 58868, September 22, 2011).

It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, vessel interactions, and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, others remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

There are five subpopulations of loggerhead sea turtles in the western North Atlantic (recognized as recovery units in the 2008 recovery plan for the species). These subpopulations show limited evidence of interbreeding. As described in the *Status of the Species*, recent assessments have evaluated the nesting trends for each recovery unit. Nesting trends are based on nest counts or nesting females; they do not include non-nesting adult females, adult males, or juvenile males or females in the population. Nesting trends for each of the loggerhead sea turtle recovery units in the Northwest Atlantic Ocean DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Estimates of the total loggerhead population in the Atlantic are not currently available. However, there is some information available for portions of the population. From 2004-2008, the loggerhead adult female population for the Northwest Atlantic ranged from 20,000 to 40,000 or more individuals (median 30,050), with a large range of uncertainty in total population size (NMFS SEFSC 2009). The estimate of Northwest Atlantic adult loggerhead females was considered conservative for several reasons. The number of nests used for the Northwest Atlantic was based primarily on U.S. nesting beaches. Thus, the results are a slight underestimate of total nests because of the inability to collect complete nest counts for many non-U.S. nesting beaches within the DPS. In estimating the current population size for adult nesting female loggerhead sea turtles, the report simplified the number of assumptions and reduced uncertainty by using the minimum total annual nest count (i.e., 48,252 nests) over the five years. This was a particularly conservative assumption considering how the number of nests and nesting females can vary widely from year to year (e.g., the 2008 nest count was 69,668 nests, which would have increased the adult female estimate proportionately to between 30,000 and 60,000). In addition, minimal assumptions were made about the distribution of remigration intervals and nests per female parameters, which are fairly robust and well known. A loggerhead population estimate using data from 2001-2010 estimated the loggerhead adult female population in the Northwest Atlantic at 38,334 individuals (SD =2,287) (Richards et al. 2011). These population studies are consistent with the definition of the Northwest Atlantic DPS.

The AMAPPS surveys and sea turtle telemetry studies conducted along the U.S. Atlantic coast in the summer of 2010 provided preliminary regional abundance estimate of about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS 2011c). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified sea turtle sightings (NMFS 2011c). Although there is much uncertainty in these population estimates, they provide some context for evaluating the size of the likely population of loggerheads in the Northwest Atlantic which is an indication of the size of the Northwest Atlantic DPS.

The impacts to Northwest Atlantic DPS loggerhead sea turtles from the proposed action are expected to result in the mortality of 21 individuals due to vessel strike over the 40-year construction, operations and decommissioning period; the capture of up to 7 loggerheads from the DPS during the proposed trawl surveys, we expect these individuals will be released alive with only minor, recoverable injuries (minor scrapes and abrasions); and, the exposure of up to 816 loggerhead sea turtles from the DPS to noise that will result in TTS and/or behavioral disturbance that meets the ESA definition of harassment. We determined that all other effects of the action would be insignificant or extremely unlikely to occur. In total, we expect the proposed action to result in the mortality of up to 21 Northwest Atlantic (NWA) DPS loggerheads over the 40-year life of the project.

The 816 loggerhead sea turtles that experience harassment would experience behavioral disturbance and could suffer temporary hearing impairment (TTS); we also expects these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time. Any sea turtles affected by TTS would experience a temporary, recoverable, hearing loss manifested as a threshold shift around the frequency of the pile driving noise. Sea turtles are not known to depend heavily on acoustic cues for vital biological functions (Nelms et al. 2016; Popper et al. 2014), and instead, may rely primarily on senses other than hearing for interacting with their environment, such as vision and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). Because sea turtles do not vocalize or use noise to communicate, any TTS would not impact communications. However, to the extent that sea turtles do rely on acoustic cues from their environment, we expect that this temporary hearing impairment would affect frequencies utilized by sea turtles for acoustic cues such as the sound of waves, coastline noise, or the presence of a vessel or predator (Narazaki et al. 2013). If such cues increase survivorship (e.g., aid in avoiding predators, navigation), temporary loss of hearing sensitivity may have effects on the ability of a sea turtle to avoid threats which could decrease its ability to avoid those threats. TTS of sea turtles is expected to only last for several days following the initial exposure (Moein et al. 1994). Given this short period of time, and that sea turtles are not known to rely heavily on acoustic cues, while TTS may impact the ability of affected individuals to avoid threats during the few days that TTS is experienced, we do not anticipate single TTSs would have any longterm impacts on the health or reproductive capacity or success of individual sea turtles.

TTS will resolve within one week while behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 9 hours, depending on pile type, but likely much less). The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise source; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, TTS and behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption and temporary loss of hearing sensitivity would affect an individual sea turtle's fitness (i.e., survival or reproduction).

The mortality of 21 loggerhead Northwest Atlantic DPS sea turtles in the action area over the 40-year life of the project (inclusive of 3 years of in-water construction, 35 years of operations, and 2 years of decommissioning) would reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). The Peninsular Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the Northwest Atlantic DPS (Ceriani and Meylan 2017, NMFS and USFWS 2008). We expect that the majority of loggerheads in the action area originated from the Northern Recovery Unit (NRU) or the Peninsular Florida Recovery Unit (PFRU).

The Northern Recovery Unit, from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989-2008, and approximately 1,272 nesting females (NMFS and U.S. FWS 2008). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and U.S. FWS 2007a). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer- term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3 percent (Bolten et al. 2019).

Annual nest totals for the PFRU averaged 64,513 nests from 1989-2007, representing approximately 15,735 females per year (NMFS and USFWS 2008). Nest counts taken at index beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). From 2009 through 2013, a 2 percent decrease for the Peninsular Florida Recovery Unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests; however, an increase in the number of nests was observed from 2007 to 2018 (Bolten et al. 2019).

The loss of 21 NWA DPS loggerheads over the 40 years of the project represents an extremely small percentage of the number of sea turtles in the PFRU or NRU. Even if the total population of the PFRU was limited to 15,735 loggerheads (the number of nesting females), the loss of 21 individuals would represent approximately 0.13% of the population. If the total NRU population was limited to 1,272 sea turtles (the number of nesting females), and all 21 individuals originated from that population, the loss of those individuals would represent approximately 1.65% of the population; however, given the distribution of loggerheads from the different nesting beaches, this is an unlikely outcome. Even just considering the number of adult nesting females the loss of 21 individuals over 40 years is extremely small and would be even smaller when considered for the total recovery unit and represents an even smaller percentage of the DPS as a whole.

As noted in the *Environmental Baseline*, the status of loggerhead Northwest Atlantic DPS sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project (stable to increasing). The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the DPS as a whole. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the Northwest Atlantic DPS. We make this conclusion in consideration of the status of the DPS as a whole, the status of loggerhead NWA DPS sea turtles in the action area, and in consideration of the threats experienced by NWA DPS loggerheads in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion. As described in section 7.10, climate change may result in changes in the distribution or abundance of loggerheads in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

Any effects on reproduction are limited to the future reproductive output of the individuals that die. Even assuming that all of these losses were reproductive female (which is unlikely given the expected even sex ratio in the action area), given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this extremely small reduction in potential nesters is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any recovery unit or the DPS as a whole. The proposed actions will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the DPS that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual loggerheads through behavioral disturbance changes in distribution will be temporary and limited to movements to nearby areas in the WDA. As explained in section 7, we expect the project to have insignificant effects on use of the action area by Northwest Atlantic DPS loggerheads.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of this DPS of loggerheads because the DPS is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the DPS population and the number of loggerheads in the DPS is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of 21 NWA DPS loggerheads over the 40 year life of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the DPS will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect Northwest Atlantic DPS loggerheads in a way that prevents the DPS from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads in this DPS from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 21 loggerheads represents an extremely small percentage of the DPS as a whole; (2) the death of 21 loggerheads will not change the status or trends of any recovery unit or the DPS as a whole; (3) the loss of 21 loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 21 Northwest Atlantic DPS loggerheads is likely to have an extremely small effect on reproductive output that will be insignificant at the recovery unit or DPS level; (5) the actions will have only a minor and temporary effect on the distribution of NWA DPS loggerheads in the action area and no effect on the distribution of the DPS throughout its range; and, (6) the actions will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that this DPS of loggerhead sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the USFWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have a stable trend; as explained above, the loss of 21 NWA DPS loggerheads over the life span of the proposed actions will not affect the population trend. The number of loggerheads likely to die as a result of the proposed actions is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches and nesting beaches will therefore not be affected; all effects to habitat within the action area will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent this DPS of the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be negligible over the long-term and the actions are not expected to have long term impacts on the future growth of the DPS or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that the NWA DPS of loggerhead sea turtles can be brought to the point at which their listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the NWA DPS of loggerhead sea turtles.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the NWA DPS of loggerhead sea turtles. These conclusions were made in consideration of the threatened status of NWA DPS loggerhead sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of loggerhead sea turtles in the action area.

9.4.2 North Atlantic DPS of Green Sea Turtles

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As described in the *Status of the Species*, the North Atlantic DPS of green sea turtles is the largest of the 11 green turtle DPSs with an estimated abundance of over 167,000 adult females from 73 nesting sites. All major nesting populations demonstrate long-term increases in abundance (Seminoff et al. 2015b). In 2021, green turtle nest counts on the 27-core index beaches in Florida reached more than 24,000 nests recorded. Green sea turtles face numerous threats on land and in the water that affect the survival of all age classes. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue for this DPS, the DPS appears to be somewhat resilient to future perturbations. As described in the *Environmental Baseline* and *Cumulative Effects*, North Atlantic DPS green sea turtles in the action area are exposed to pollution and experience vessel strike and fisheries bycatch. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of North Atlantic DPS green sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

There are four regions that support high nesting concentrations in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), United States (Florida), and Cuba. Using data from 48 nesting sites in the North Atlantic DPS, nester abundance was estimated at 167,528 total nesters (Seminoff et al. 2015). The years used to generate the estimate varied by nesting site but were between 2005 and 2012. The largest nesting site (Tortuguero, Costa Rica) hosts 79 percent of the estimated nesting. It should be noted that not all female turtles nest in a given year (Seminoff et al. 2015). Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff et al. 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff et al. 2015). Nesting sites in Cuba, Mexico, and the United States were either stable or increasing (Seminoff et al. 2015). More recent data is available for the southeastern United States. Nest counts at Florida’s core index beaches have ranged from less than 300 to almost 41,000 in 2019. The Index Nesting Beach Survey (INBS) is carried out on a subset of beaches surveyed during the Statewide Nesting Beach Survey (SNBS) and is designed to measure trends in nest numbers. The nest trend in Florida shows the typical biennial peaks in abundance and has been increasing (https://myfwc.com/research/wildlife/sea- turtles/nesting/beach-survey-totals/). The SNBS is broader but is not appropriate for evaluating trends. In 2019, approximately 53,000 green turtle nests were recorded in the SNBS (https://myfwc.com/research/wildlife/sea-turtles/nesting/). Seminoff et al. (2015) estimated total nester abundance for Florida at 8,426 turtles.

NMFS recognizes that the nest count data available for green sea turtles in the Atlantic indicates increased nesting at many sites. However, we also recognize that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future.

The impacts to North Atlantic DPS green sea turtles from the proposed action are expected to result in the harassment (inclusive of TTS and behavioral disturbance) of 2 individuals due to exposure to pile driving noise; the mortality of 2 individuals due to vessel strike over the 40-year life of the project inclusive of construction, operations, and decommissioning; and, the capture of up to 1 green sea turtle in the trawl surveys, we expect this individual will be released alive with only minor, recoverable injuries (minor scrapes and abrasions). We determined that all other effects of the action would be insignificant or extremely unlikely. In total, we anticipate the proposed action will result in the mortality of 2 North Atlantic DPS green sea turtle over the 40-year life of the project.

The 2 green sea turtles that experience harassment would experience behavioral disturbance and could suffer temporary hearing impairment (TTS); we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time. Any sea turtle affected by TTS would experience a temporary, recoverable, hearing loss manifested as a threshold shift around the frequency of the pile driving noise. Sea turtles are not known to depend heavily on acoustic cues for vital biological functions (Nelms et al. 2016; Popper et al. 2014), and instead, may rely primarily on senses other than hearing for interacting with their environment, such as vision and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). Because sea turtles do not vocalize or use noise to communicate, any TTS would not impact communications. However, to the extent that sea turtles do rely on acoustic cues from their environment, we expect that this temporary hearing impairment would affect frequencies utilized by sea turtles for acoustic cues such as the sound of waves, coastline noise, or the presence of a vessel or predator (Narazaki et al. 2013). If such cues increase survivorship (e.g., aid in avoiding predators, navigation), temporary loss of hearing sensitivity may have effects on the ability of a sea turtle to avoid threats which could decrease its ability to avoid those threats. TTS of sea turtles is expected to only last for several days following the initial exposure (Moein et al. 1994). Given this short period of time, and that sea turtles are not known to rely heavily on acoustic cues, while TTS may impact the ability of affected individual to avoid threats during the few days that TTS is experienced, we do not expect the anticipated TTS would have any longterm impacts on the health or reproductive capacity or success of the affected individual.

TTS will resolve within one week while behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 9 hours, depending on pile type, but likely much less).

The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise source; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, TTS and behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption and temporary loss of hearing sensitivity would affect an individual sea turtle's fitness (i.e., survival or reproduction).

The death of two North Atlantic DPS green sea turtles, whether a male or female, immature or mature, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed actions assuming all other variables remained the same. The loss of two green sea turtles represents a very small percentage of the DPS as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of North Atlantic DPS green sea turtles, the mortality of two NA DPS green turtles represents less than 0.012% of the DPS's nesting population. The loss of these sea turtles would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the *Status of the Species* section above, we consider the trend for North Atlantic DPS green sea turtles to be stable. As noted in the Environmental Baseline, the status of North Atlantic DPS green sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project. As explained below, the death of these 2 NA DPS green sea turtles will not appreciably reduce the likelihood of survival for this DPS for the reasons outlined below. We make this conclusion in consideration of the status of the DPS as a whole, the status of North Atlantic DPS green sea turtles in the action area, and in consideration of the threats experienced by green sea turtles in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: this DPS of the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable. The proposed actions are not likely to reduce distribution of greens because the actions will not cause more than a temporary disruption to foraging and migratory behaviors.

Based on the information provided above, the death of two North Atlantic DPS green sea turtles over the 40-year life of the project, will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that this DPS of the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect green sea turtles in a way that prevents this DPS of the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the DPS for this species' nesting trend is increasing; (2) the death of 2 green sea turtles represents an extremely small percentage of the DPS as a whole; (3) the loss of 2 green sea turtles will not change the status or trends of the DPS as a whole; (4) the loss of 2 green sea turtles is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of 2 green sea turtles is likely to have a negligible or undetectable effect on reproductive output of the DPS as a whole; (6) the action will have insignificant and temporary effects on the distribution of greens in the action area and no effect on its distribution throughout the DPS's range; and (7) the action will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that this DPS of green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that this DPS of the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria, which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one" recovery tasks must be achieved, nesting habitat must be protected (through public ownership of nesting beaches), and stage class mortality must be reduced.

The proposed actions will not appreciably reduce the likelihood of survival of green sea turtles in this DPS. Also, it is not expected to modify, curtail or destroy the range of the DPS since it will result in an extremely small reduction in the number of green sea turtles in any geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed actions are likely to result in the mortality of two North Atlantic DPS green sea turtles; however, as explained above, the loss of these individuals over this time period is not expected to affect the persistence of green sea turtles or the trend for this DPS of the species. The actions will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent this DPS of the species from growing in a way that leads to recovery, and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of two individuals, these effects will be negligible or undetectable in the DPS over the long-term, and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that green sea turtles in this DPS can be brought to the point at which their listing as endangered or threatened is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of this DPS of green sea turtles.

Despite the threats faced by individual North Atlantic DPS green sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the DPS of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

Based on the analysis presented herein, the effects of the proposed actions are not likely to appreciably reduce the likelihood of both the survival and recovery of the North Atlantic DPS of green sea turtles. These conclusions were made in consideration of the threatened status of the North Atlantic DPS of green sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of green sea turtles in the action area.

9.4.3 Leatherback Sea Turtles

Leatherback sea turtles are listed as endangered under the ESA. Leatherbacks are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and USFWS 2013). Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed.

The most recent published assessment, the leatherback status review, estimated that the total index of nesting female abundance for the Northwest Atlantic population of leatherbacks is 20,659 females (NMFS and USFWS 2020). This abundance estimate is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). The IUCN Red List assessment for the NW Atlantic Ocean subpopulation estimated 20,000 mature individuals (male and female) and approximately 23,000 nests per year (data through 2017) with high inter-annual variability in annual nest counts within and across nesting sites (Northwest Atlantic Leatherback Working Group 2019). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and USFWS 2020). For this analysis, we found that the status review estimate of 20,659 nesting females represents the best available scientific information given that it uses the most comprehensive and recent demographic trends and nesting data.

In the 2020 status review, the authors identified seven leatherback populations that met the discreteness and significance criteria of DPSs (NMFS and USFWS 2020). These include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. The population found within the action area is that identified in the status review as the Northwest Atlantic DPS. While NMFS and USFWS concluded that seven populations met the criteria for DPSs, the species continues to be listed as a species at the global level across its entire range (85 FR 48332, August 10, 2020) as the agency has taken no action to list one or more DPSs. While we reference the DPSs and stocks to analyze the status and trends of various populations, our jeopardy analysis is based on the range-wide status of the species as listed.

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari et al. 2013b). However, as described in the *Status of the Species*, more recent analyses indicate that the overall trends are negative (NMFS and USFWS 2020, Northwest Atlantic Leatherback Working Group 2018, 2019). At the stock level, the Working Group evaluated the NW Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean stocks. The NW Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods evaluated, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana; Suriname; Cayenne, French Guiana; and Matura, Trinidad. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). Slight increases in nesting were seen in 2018 and 2019, however, nest counts remain low compared to 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The Northern Caribbean and Western Caribbean stocks have also declined. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent period.

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. This trend is considered to be representative of the DPS (NMFS and USFWS 2020). Data also indicated that the Southwest Atlantic DPS is declining (NMFS and USFWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris et al. 2017, Santidrián Tomillo et al. 2017, Santidrián Tomillo et al. 2007, Sarti Martínez et al. 2007, Tapilatu et al. 2013). The IUCN Red List assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013a). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific DPS at 1,277 females for the West Pacific DPS and 755 females for the East Pacific DPS (NMFS and USFWS 2020). The East Pacific DPS has exhibited a decreasing trend since monitoring began with a 97.4 percent decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Most recently, the 2020 status review estimated that the total index of nesting female abundance for the SW Indian

DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS and USFWS 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and USFWS 2020).

The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting; of these, as described in the *Environmental Baseline* and *Cumulative Effects*, fisheries bycatch occurs in the action area. Leatherback sea turtles in the action area are also at risk of vessel strike. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of leatherback sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The impacts to leatherback sea turtles from the proposed action are expected to result in the harassment (inclusive of TTS) of 25 individuals due to exposure to impact pile driving noise. We also expect that 2 leatherbacks will be struck and killed by a project vessel over the 40-year life of the project inclusive of construction, operations, and decommissioning. We do not expect the capture of any leatherbacks in the trawl surveys. We determined that all other effects of the action would be insignificant or extremely unlikely to occur and discountable. In total, over the 40-year life of the project, we anticipate the proposed action will result in the mortality of 2 and the harassment of 25 (inclusive of TTS) leatherback sea turtles.

The 25 leatherback sea turtles that experience harassment would experience behavioral disturbance and could suffer temporary hearing impairment (TTS); we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time. Any sea turtles affected by TTS would experience a temporary, recoverable, hearing loss manifested as a threshold shift around the frequency of the pile driving noise. Sea turtles are not known to depend heavily on acoustic cues for vital biological functions (Nelms et al. 2016; Popper et al. 2014), and instead, may rely primarily on senses other than hearing for interacting with their environment, such as vision and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). Because sea turtles do not vocalize or use noise to communicate, any TTS would not impact communications. However, to the extent that sea turtles do rely on acoustic cues from their environment, we expect that this temporary hearing impairment would affect frequencies utilized by sea turtles for acoustic cues such as the sound of waves, coastline noise, or the presence of a vessel or predator (Narazaki et al. 2013). If such cues increase survivorship (e.g., aid in avoiding predators, navigation), temporary loss of hearing sensitivity may have effects on the ability of a sea turtle to avoid threats which could decrease its ability to avoid those threats. TTS of sea turtles is expected to only last for several days following the initial exposure (Moein et al. 1994). Given this short period of time, and that sea turtles are not known to rely heavily on acoustic cues, while TTS may impact the ability of affected individuals to avoid threats during the few days that TTS is experienced, we do not anticipate single TTSs would have any longterm impacts on the health or reproductive capacity or success of individual sea turtles.

TTS will resolve within one week while behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 9 hours, depending on pile type, but likely much less). The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise sourced; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, TTS and behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption and temporary loss of hearing sensitivity would affect an individual sea turtle's fitness (i.e., survival or reproduction).

As noted above, the proposed project is expected to result in the mortality of no more than 2 leatherbacks. The death of 2 leatherbacks due to vessel strike over the life span of the project represents an extremely small percentage of the number of leatherbacks in the North Atlantic, just 0.01% even considering the lowest population estimate of nesting females (20,659; NMFS and USFWS 2020) and an even smaller percentage of the species as a whole. Considering the extremely small percentage of the population that will be killed, it is unlikely that this death will have a detectable effect on the numbers and population trends of leatherbacks in the North Atlantic or the species as a whole.

Any effects on reproduction are limited to the future reproductive output of the individual killed. Even assuming that the mortality is to a reproductive female, given the number of nesting females in this population (20,659), it is unlikely that the expected loss of no more than 2 leatherbacks over 40 years would affect the success of nesting in any year. Additionally, this extremely small reduction in a potential nester is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any nesting beach or the population as a whole. The proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual leatherbacks through behavioral disturbance, changes in distribution will be temporary and limited to movements to nearby areas in the WDA. As explained in section 7, we expect the project to have insignificant effects on use of the action area by leatherbacks.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of leatherbacks because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of leatherbacks is likely to be stable or increasing over the period considered here.

Based on the information provided above, the death of 2 leatherbacks over the 40-year life of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect leatherbacks in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent leatherbacks from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 2 leatherbacks represents an extremely small percentage of the Northwest Atlantic population and an even smaller percentage of the species as a whole; (2) the death of 2 leatherbacks will not change the status or trends of any nesting beach, the Northwest Atlantic population or the species as a whole; (3) the loss of 2 leatherback is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 2 leatherbacks is likely to have an extremely small effect on reproductive output that will be insignificant at the nesting beach, population, or species level; (5) the actions will have only a minor and temporary effect on the distribution of leatherbacks in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of leatherbacks to shelter and only an insignificant effect on individual foraging leatherbacks.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that leatherbacks can rebuild to a point where listing is no longer appropriate. In 1992, NMFS and the USFWS issued a recovery plan for leatherbacks in the U.S. Caribbean, Atlantic, and Gulf of Mexico (NMFS and USFWS 1992). The plan includes three recovery objectives:

1) The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.
2) Nesting habitat encompassing at least 75 percent of nesting activity in USVI, Puerto Rico, and Florida is in public ownership.
3) All priority one tasks have been successfully implemented.

The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Because the death of 2 leatherbacks over the 40-year life of the project is such a small percentage of the population and is not expected to affect the status or trend of the species, it will not affect the likelihood that the adult female population of loggerheads increases over time. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of leatherbacks and a small reduction in the amount of potential reproduction due to the loss of these individual, these effects will be negligible or undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the species or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles can be brought to the point at which their listing as endangered or threatened is no longer appropriate. Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached here do not change.

Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of leatherback sea turtles. These conclusions were made in consideration of the endangered status of leatherback sea turtles, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance and distribution of leatherback sea turtles in the action area; that is, the proposed action will not appreciably reduce the likelihood of recovery of leatherback sea turtles.

Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

Based on the analysis presented herein, the effects of the proposed action, are not likely to appreciably reduce the likelihood of both the survival and recovery of leatherback sea turtles. These conclusions were made in consideration of the endangered status of leatherback sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of leatherback sea turtles in the action area.

9.4.4 Kemp's Ridley Sea Turtles

Kemp's ridley sea turtles are listed as an endangered species under the ESA. They occur in the Atlantic Ocean and Gulf of Mexico, the only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963, NMFS and USFWS 2015, USFWS and NMFS 1992).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with other sea turtles species, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females and the age structure of the population, nest counts cannot be used to estimate the total population size (Meylan 1982, Ross 1996). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. It is the best proxy we have for estimating population changes.

Following a significant, unexplained one-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database, unpublished data). In 2013 and 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 nests, and in 2016 overall numbers increased to 18,354 recorded nests. There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm. to NMFS SERO PRD, August 31, 2017 as cited in NMFS 2020(c) and decreases observed in 2018 and again in 2019. In 2019, there were 11,140 nests in Mexico. It is unknown whether this decline is related to resource fluctuation, natural population variability, effects of catastrophic events like the Deepwater Horizon oil spill affecting the nesting cohort, or some other factor. A small nesting population is also emerging in the United States, primarily in Texas. From 1980-1989, there were an average of 0.2 nests/year at Padre Island National Seashore (PAIS), rising to 3.4 nests/year from 1990-1999, 44 nests/year from 2000-2009, and 110 nests per year from 2010-2019. There was a record high of 353 nests in 2017 (NPS 2020). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017 (NMFS 2020c) and decreases in nesting in 2018 and 2019 (NPS 2020).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (NMFS and USFWS 2015, TEWG 2000). Gallaway et al. (2016) developed a stock assessment model for Kemp's ridley to evaluate the relative contributions of conservation efforts and other factors toward this species' recovery. Terminal population estimates for 2012 summed over ages 2 to 4, ages 2+, ages 5+, and ages 9+ suggest that the respective female population sizes were 78,043 (SD = 14,683), 152,357 (SD = 25,015), 74,314 (SD =10,460), and 28,113 (SD = 2,987) (Gallaway et al. 2016). Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of 2 years, and a sex ratio of 3.17 females: 1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). However, some positive outlooks for the species include recent conservation actions, including the expanded TED requirements in the shrimp fishery (84 FR 70048, December 20, 2019) and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and USFWS 2015).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true, then rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Fishery interactions are the main threat to the species. The species' limited range and low global abundance make its resilience to future perturbation low. The status of Kemp's ridley sea turtles in the action area is the same as described in the Status of the Species. As described in the Environmental Baseline and Cumulative Effects, fisheries bycatch and vessel strike are likely to continue to occur in the action area over the life of the project. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Kemp's ridley sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The impacts to Kemp's ridley sea turtles from the proposed action are expected to result in the harassment (inclusive of TTS) of 48 individuals due to exposure to impact pile driving noise. We also expect that 3 Kemp's ridley sea turtles will be struck and killed by a project vessel over the 40-year life of the project inclusive of construction, operations, and decommissioning. We expect the capture of up to 5 Kemp's ridley sea turtles during the trawl surveys; we expect these individuals will be released alive with only minor, recoverable injuries (minor scrapes and abrasions). We determined that all other effects of the action would be insignificant or extremely unlikely to occur. In total, we expect the proposed action to result in the mortality of 3 Kemp's ridley sea turtles over the 40-year life of the project.

The 48 Kemp's ridley sea turtles that experience harassment would experience behavioral disturbance and could suffer temporary hearing impairment (TTS); we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time. Any sea turtles affected by TTS would experience a temporary, recoverable, hearing loss manifested as a threshold shift around the frequency of the pile driving noise. Sea turtles are not known to depend heavily on acoustic cues for vital biological functions (Nelms et al. 2016; Popper et al. 2014), and instead, may rely primarily on senses other than hearing for interacting with their environment, such as vision and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). Because sea turtles do not vocalize or use noise to communicate, any TTS would not impact communications. However, to the extent that sea turtles do rely on acoustic cues from their environment, we expect that this temporary hearing impairment would affect frequencies utilized by sea turtles for acoustic cues such as the sound of waves, coastline noise, or the presence of a vessel or predator (Narazaki et al. 2013). If such cues increase survivorship (e.g., aid in avoiding predators, navigation), temporary loss of hearing sensitivity may have effects on the ability of a sea turtle to avoid threats which could decrease its ability to avoid those threats. TTS of sea turtles is expected to only last for several days following the initial exposure (Moein et al. 1994). Given this short period of time, and that sea turtles are not known to rely heavily on acoustic cues, while TTS may impact the ability of affected individuals to avoid threats during the few days that TTS is experienced, we do not expect the anticipated TTS would have any longterm impacts on the survival, health or reproductive capacity or success of individual sea turtles.

TTS will resolve within one week while behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 9 hours, depending on pile type, but likely much less). The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise sourced; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, TTS and behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption and temporary loss of hearing sensitivity would affect an individual sea turtle's fitness (i.e., survival or reproduction).

The mortality of 3 Kemp's ridleys over a 40 year time period represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females (7-8,000), the death of one Kemp's ridley represents less than 0.043% of the nesting female population. While the death of three Kemp's ridley sea turtles will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population. Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals.

A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction, as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated

7-8,000 nesting females. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of 3 Kemp's ridley sea turtles over 40 years would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

Based on the information provided above, the death of 3 Kemp's ridley sea turtles over 40 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 3 Kemp's ridleys represents an extremely small percentage of the species as a whole; (3) the death of 3 Kemp's ridleys will not change the status or trends of the species as a whole; (4) the loss of these Kemp's ridley is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these Kemp's ridleys is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the actions will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS et al. 2011). The plan includes a list of criteria necessary for recovery, including:

1. An increase in the population size, specifically in relation to nesting females[57];
2. An increase in the recruitment of hatchlings[58];
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Kemp's ridleys have an increasing trend; as explained above, the loss of 3 Kemp's ridleys over the 40-year life of the project will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed actions is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that criteria one, two, or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches and nesting beaches will not be affected; therefore, the proposed actions will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that criteria five will be met.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction, these effects will be negligible or undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which their listing as endangered or threatened is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of Kemp's ridley sea turtles.

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[57] A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur

[58] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed action in light of the status of the species, Environmental Baseline and cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change.

Based on the analysis presented herein, the effects of the proposed action, including the mortality of 3 Kemp's ridleys, are not likely to appreciably reduce the likelihood of both the survival and recovery of this species. These conclusions were made in consideration of the endangered status of Kemp's ridley sea turtles, effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance and distribution of Kemp's ridleys in the action area.

9.5 Marine Mammals

We determined that exposure to project noise other than pile driving (e.g., noise from operational WTGs) will have effects that are insignificant or are extremely unlikely to occur. We also determined that adverse effects to habitat and prey are either not reasonably certain to occur or are insignificant or discountable and concluded that with the incorporation of vessel strike risk reduction measures that are part of the proposed action, strike of an ESA listed whale by a project vessel is extremely unlikely to occur. Additionally, entanglement or capture in fisheries surveys is extremely unlikely to occur.

Our effects analysis determined that pile driving is likely to adversely affect ESA-listed marine mammals in the action area and cause temporary threshold shift (TTS), behavioral response, and stress in a small number of individual North Atlantic right, fin, sei, and sperm whales; we determined these effects meet the definition of harassment in the context of ESA take. As addressed in section 7.1, animals exposed to sufficiently intense sound exhibit an increased hearing threshold (i.e., poorer sensitivity) for some period of time following exposure; this is called a noise-induced threshold shift (TS). The magnitude of TS normally decreases over time following cessation of the noise exposure, TS that eventually returns to zero (i.e., the threshold returns to the pre-exposure value), is called TTS (Southall et al. 2007). TTS represents primarily tissue fatigue and is reversible (Southall et al., 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.*, Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Additionally, up to 8 fin and 3 sei whales are expected to be exposed to impact pile driving noise that would result in PTS, which will be a minor, but permanent, hearing impairment that is considered an injury and meets the ESA definition of harm. No injury of any kind, including PTS, is anticipated for any right or sperm whales. In this section, we discuss the likely consequences of the anticipated adverse effects to the individual whales that have been exposed, the populations those individuals represent, and the species those populations comprise.

Our analyses identified the likely effects of the Atlantic Shores project, which requires authorizations from a number of federal agencies as described in section 3 of this Opinion, on the ESA-listed species that will be exposed to these actions. We measure effects to individuals of endangered or threatened marine mammals using changes in the individual's "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect listed marine mammals exposed to an action's effects to experience reductions in fitness, we would not expect the action to impact that animal's health or future reproductive success. Therefore, we would not expect adverse consequences on the overall reproduction, abundance, or distribution of the populations those individuals represent or the species those populations comprise. As a result, if we conclude that listed animals are not likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that listed animals are likely to experience reductions in their fitness, we would assess the consequences of those fitness reductions for the population represented in an action area and the species the population supports.

As documented in section 7 of this Opinion, the adverse effects anticipated on North Atlantic right, fin, sei, and sperm whales resulting from the proposed action are from sounds produced during pile driving to install WTG, OSS, and Met Tower foundations and to install and remove cofferdams. While this Opinion relies on the best available scientific and commercial information as cited herein, our analysis and conclusions include uncertainty about the basic hearing capabilities of some marine mammals; how these animals use sounds as environmental cues; how they perceive acoustic features of their environment; the importance of sound to the normal behavioral and social ecology of species; the mechanisms by which human-generated sounds affect the behavior and physiology (including the non-auditory physiology) of exposed individuals; and the circumstances that could produce outcomes that have adverse consequences for individuals and populations of exposed species. Based on the best available information and exercising our best professional judgment, as explained in section 7 of this Opinion, we expect the effects of exposure to noise from impact pile driving below the MMPA Level A harassment threshold but above the MMPA Level B harassment threshold to have adverse, but temporary, effects on the behavior of individual fin, right, sei, and sperm whales that we have determined to cause harassment under the ESA. As is evident from the available literature cited herein, responses are expected to be short-term, with the animal returning to normal behavior patterns shortly after the exposure is over (e.g., Goldbogen et al. 2013a; Silve et al. 2015). While Southall et al. (2016) suggested that even minor, sub-lethal behavioral changes may still have significant energetic and physiological consequences given sustained or repeated exposure, as explained in section 7 of this Opinion, we do not expect such sustained or repeated exposure of any individuals in this case.

9.5.1 North Atlantic Right Whales

As described in the *Status of the Species*, the endangered North Atlantic right whale is currently in decline in the western North Atlantic (Pace et al. 2017b; Pace et al. 2021) and experiencing an unusual mortality event (Daoust et al. 2017). The 2022 SAR (Hayes et al. 2023) uses data from the photo-ID database as it existed in December 2021 and included photographic information up through November 2020. Using the hierarchical, state-space Bayesian open population model of these histories produced a median abundance value (N_{est}) as of November 30, 2020 of 338 individuals (95%CI: 325–350) and a minimum population estimate of 332. Using the same modeling approach (Pace et al. 2017, Pace 2021), Linden (2023) updated the population size estimate of North Atlantic right whales (at the beginning of 2022 using the most recent year of available sightings data (collected through December 2022). The estimated population size in 2022 was 356 whales, with a 95% credible interval ranging from 346 to 363. As noted in that paper, the sharp decrease observed from 2015-2020 appears to have slowed, though the right whale population continues to experience annual mortalities above recovery thresholds.

Modeling indicates that low female survival, a male-biased sex ratio, and low calving success are contributing to the population's current decline (Pace et al. 2017b). The species has low genetic diversity, as would be expected based on its low abundance, and the species' resilience to future perturbations (i.e., its ability to recover from declines in numbers of reductions) is expected to be very low (Hayes et al. 2018). Vessel strikes and entanglement of right whales in U.S. and Canadian waters continue to occur. Entanglement in fishing gear appears to have had substantial health and energetic costs that affect both survival and reproduction of right whales (van der Hoop et al. 2017a). Due to the declining status of North Atlantic right whales, the resilience of this population to stressors that would impact the distribution, abundance, and reproductive potential of the population is low. The species faces a high risk of extinction and the population size is small enough for the death of any individuals to have measurable effects in the projections on its population status, trend, and dynamics.

As described in the *Environmental Baseline* and *Status of the Species* sections, ongoing effects in the action area (e.g., global climate change, decreased prey abundance, vessel strikes, and entanglements in U.S. state and federal fisheries) have contributed to concern for the species' persistence. Sublethal effects from entanglement cannot be separated out from other stressors (e.g., prey abundance, climate variation, reproductive state, vessel collisions) which co-occur and affect calving rates. Entanglement in fishing gear and vessel strikes are currently understood to be the most significant threats to the species and, as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change is expected to continue to negatively affect right whales throughout their range, including in the action area, over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The distribution of right whales overlaps with some parts of the vessel transit routes that will be used through the 40-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where right whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a right whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a right whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

Based on the type of survey gear that will be deployed, we concluded that all effects to right whales from the surveys of fishery resources planned by Atlantic Shores and considered as part of the proposed action will be insignificant or discountable. We have concluded that capture or entanglement of a right whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on right whale prey. As right whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (350 m or less) and any effects to right whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to right whales is very small. Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough way to avoid it (less than 500 m), effects are insignificant.

A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of right whales to pile driving noise. With these measures in place, we do not anticipate the exposure of any right whales to noise that could result in PTS, other injury, or mortality. However, even with these avoidance and minimization measures in place, we expect 20 North Atlantic right whales to experience TTS, temporary behavioral disturbance (up to approximately 9 hours) and associated temporary physiological stress during the construction period due to exposure to pile driving noise. As explained in the *Effects of the Action* section, all of these impacts, including TTS, are expected to be temporary with normal behaviors resuming quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the longterm health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 20 right whales exposed to noise above the MMPA Level B harassment threshold would be likely to increase the risk of vessel strike or entanglement in fishing gear. We would not expect the TTS to span the entire communication or hearing range of right whales given the frequencies produced by pile driving do not span entire hearing ranges for right whales. Additionally, though the frequency range of TTS that right whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. As such, any effects of TTS on the ability of a right whale to communicate with other right whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats are expected to be minor and temporary. As such, we do not expect TTS or masking to affect the ability of a right whale to avoid a vessel or any other threat that may be detected with acoustic cues. These risks are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). In addition, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in right whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters.

We have considered if pile driving noise may mask right whale calls and could have effects on mother-calf communication and behavior. As noted in section 7.1, presence of mother-calf pairs is unlikely in the WDA during the May – December pile driving window. However, even if a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. As noted in section 7.1, when calves leave the foraging grounds off the coast of the southeastern U.S. at around four months of age, they are expected to be more robust and less susceptible to a missed or delayed nursing opportunity. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise; no longer than hours, and likely far less time than that. This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.

We expect that right whales in the WDA are migrating, or socializing, with limited, occasional, and opportunistic foraging occurring. As explained in the effects analysis, if suitable densities of copepod prey are present, right whales may forage in the WDA; however, the WDA is outside of the areas where right whales are documented to aggregate and persist due to the presence of prey. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 20 right whales exposed to ESA harassment levels of noise during pile driving will return to normal behavioral patterns after the exposure ends. As such, even if a right whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event on a single day.

A single impact pile driving event will take approximately 7-9 hours for a monopile and 12 hours for installation of four pin piles while vibratory installation and removal of sheet piles is expected to occur for up to 12 hours per day; therefore, even in the event that the 12 right whales expected to be exposed to impact pile driving noise and 8 right whales expected to be exposed to vibratory pile driving noise were exposed to disturbing levels of noise for the entirety of a pile driving event, that disturbance would last less than 12 hours. However, considering the area where noise will be elevated and the anticipated swim speed and behavioral response (avoidance), exposure is expected to be for considerably shorter period for both impact and vibratory pile driving events. An animal exhibiting the anticipated avoidance response to pile driving noise would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the MMPA Level B harassment threshold would take a direct path to get outside of the noisy area. As explained in section 7.1, during impact pile driving of foundations, the area with noise above the Level B harassment threshold extends approximately 2.2-4.5 km from the pile being driven, while during vibratory pile driving that zone extends approximately 11 km from the pile. As such, considering a right whale that was at the edge of the clearance zone when impact pile driving starts, we would expect that right whale swimming at maximum speed (9 kph) would escape from the area with noise above 160 dB re 1uPa the noise in about 20 minutes, but at the median speed observed in Hatin et al. (1.3 kph, 2013), it would take the animal approximately 3.5 hours to move out of the noisy area.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, and disruption of a single foraging event, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). Similarly, the disruption of a single foraging event lasting for a few hours on a single day is not expected to affect the health of an animal, even an animal in poor condition. The energetic consequences of the evasive behavior and delay in resting or foraging for a few hours on a single day are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated to occur as a result of noise exposure and the accompanying behavioral response. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase of stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which elevated noise will be experienced, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in long-term effects to affected individuals**.**

As explained in section 7 of this Opinion, the only adverse effects to North Atlantic right whales expected to result from the Atlantic Shores project are the temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment), inclusive of masking and stress, as a result of exposure to noise during impact pile driving for foundation installation. While we do not anticipate these effects to have long-term consequences, these behavioral consequences, combined with TTS, are expected to create a short-term likelihood of injury by substantially disturbing normal behavioral patterns as the disturbance is experienced: these adverse effects thus meet NMFS's interim guidance definition of take by harassment under the ESA. These adverse effects will be experienced by up to 20 individual right whales as a result of exposure to noise from pile driving. As explained in section 7 of this Opinion, these effects do not meet the ESA definition of harm. No harm, injury (auditory or other), serious injury, or mortality is expected due to exposure to any aspect of the proposed action during the construction, operations, or decommissioning phases of the project.

As described in greater detail in Section 7.1, while the anticipated behavioral disruptions, TTS, masking, and stress that are anticipated to result from exposure to noise during pile driving, will meet the ESA definition of harassment, we do not expect injury or any long-term fitness consequences to any of the up to 20 individual North Atlantic right whales that will be harassed. Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, masking, additional energy expenditure and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of North Atlantic right whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project; therefore, we do not expect this harassment to reduce the likelihood of successful migration, breeding, calving, or nursing.

In summary, while we expect the proposed action to result in the harassment of 20 right whales (i.e., short term significant disruption of behavioral patterns creating the likelihood of injury), we do not expect any actual harm, injury (auditory or otherwise), serious injury, or mortality of any right whale to result from the proposed action. We do not expect effects of the action to affect the health of any right whale. We also do not anticipate fitness consequences to any individual North Atlantic right whales; that is, we do not expect any effects on any individual's ability to reproduce or generate viable offspring. Because we do not anticipate any reduction in fitness, we do not anticipate any future effects on reproductive success to result from the proposed action. While many right whales in the action area are in a stressed state that is thought to contribute to a decreased calving interval, the short-term (no more than several hours) exposure to pile driving noise experienced by a single individual is not anticipated to have any lingering effects and is not expected to have any effect on future reproductive output. As such, we do not expect any reductions in reproduction. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the North Atlantic right whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action is not likely to affect the recovery potential of North Atlantic right whales (i.e. affect the likelihood that North Atlantic right whales can rebuild to a point where it is downlisted and ultimately listing is no longer appropriate). In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2005 Recovery Plan for North Atlantic right whales. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The 2005 Recovery Plan (NMFS 2005) states that North Atlantic right whales may be considered for reclassifying to threatened when all of the following have been met: 1) The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population; 2) The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2% per year; 3) None of the known threats to Northern right whales (summarized in the five listing factors) are known to limit the population's growth rate; and, 4) Given current and projected threats and environmental conditions, the right whale population has no more than a 1% chance of quasi-extinction in 100 years. The proposed action will not result in any condition that impacts the time it will take to reach these goals or the likelihood that these goals will be met. This is because the proposed action will not result in any mortality or have any effect on the health or reproductive success of any individuals; therefore, it will not affect the trend of the species or prevent or delay it from achieving an increasing population or otherwise affect its growth rate and will not affect the chance of quasi-extinction. That is, the proposed action will not appreciably reduce the likelihood of recovery of North Atlantic right whales.

The proposed action will not affect the abundance of right whales; because no serious injury or mortality is anticipated, the project will not cause there to be fewer right whales. The only effects to distribution of right whales will be minor changes in the movements of up to 28 individuals exposed to pile driving noise above the MMPA Level B harassment threshold resulting in ESA take by harassment; there will be no changes in the distribution of the species in the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species.

For the reasons presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of North Atlantic right whales in the wild. These conclusions were made in consideration of the endangered status of North Atlantic right whales, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects* section of this Opinion, and any anticipated effects of climate change on the abundance, reproduction, and distribution of right whales in the action area.

9.2.2 Fin Whales

The best available current abundance estimate for fin whales in the North Atlantic stock is 6,802 (CV=0.24), sum of the 2016 NOAA shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys; the minimum population estimate for the western North Atlantic fin whale is 5,573 (Hayes et al. 2022). Fin whales in the North Atlantic compromise one of the three to seven stocks in the North Atlantic. According to the latest NMFS stock assessment report for fin whales in the Western North Atlantic, information is not available to conduct a trend analysis for this population (Hayes et al. 2022). Rangewide, there are over 100,000 fin whales occurring primarily in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere.

Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of fin whales in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

As explained in the section 7 of this Opinion, with the exception of 8 fin whales expected to experience PTS due to exposure to impact pile driving noise, the only adverse effects to fin whales expected to result from the Atlantic Shores project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment); we consider these adverse effects to occur at a level meeting NMFS's interim ESA definition of harassment. These adverse effects will be experienced by up to 21 individual fin whales as a result of exposure to noise from impact pile driving, and 7 fin whales as a result of exposure to noise from vibratory pile driving of sheet piles for cofferdam installation/removal, that is below the Level A harassment threshold but above the Level B harassment threshold. With the exception of 8 fin whales expected to experience PTS, no injury (auditory or other), serious injury or mortality is expected due to exposure to any effect of the proposed action during the construction, operations, or decommissioning phases of the project.

The distribution of fin whales overlaps with some parts of the vessel transit routes that will be used through the 40-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where fin whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a fin whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a fin whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

Based on the type of survey gear that will be deployed, we determined that effects to fin whales from the surveys of fishery resources planned by Atlantic Shores and considered as part of the proposed action are extremely unlikely to occur. As such, capture or entanglement of a fin whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on fin whale prey. As fin whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (50 m or less) and any effects to fin whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to fin whales is very small (no more than 500 m from the sound source). Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough way to avoid it (less than 500 m), effects are insignificant.

A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of fin whales to noise during pile driving. However, even with these minimization measures in place, we expect up to 8 fin whales to experience PTS and up to 61 fin whales to experience TTS, temporary behavioral disturbance and associated temporary physiological stress during the construction period due to exposure to impact pile driving noise.

PTS is permanent, meaning the effects of PTS last well beyond the duration of the proposed action and outside of the action area as animals migrate. As such, PTS has the potential to affect aspects of affected animal's life functions that do not overlap in time and space with the proposed action. As explained in section 7.1, we expect that the up to 8 fin whales estimated to be exposed to pile driving noise above the MMPA Level A harassment threshold would experience slight PTS, *i.e.* minor long-term or permanent degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (*i.e.* the low-frequency region below 2 kHz), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics, much less impact reproduction or survival (87 FR 64868; October 26, 2022). No severe hearing impairment or serious injury is expected because of the received levels of noise anticipated and the short duration of exposure. The PTS anticipated is considered a minor auditory injury and as such it constitutes take by harm under the ESA. The up to 8 fin whales that are harmed will also experience the physiological (i.e., stress) and behavioral effects described below for the animals that experience TTS. As discussed previously in Section 7.1, permanent hearing impairment has the potential to affect individual whale survival and reproduction, although data are not readily available to evaluate how permanent hearing threshold shifts directly relate to individual whale fitness. Our exposure and response analyses indicate that no more than 8 fin whales would experience PTS, but this PTS is expected to be minor. With this minor degree of PTS, we do not expect it to affect the individuals' overall health, reproductive capacity, or survival. The 8 individual fin whales could be less efficient at locating conspecifics or have decreased ability to detect threats at long distances, but these animals are still expected to be able to locate conspecifics to socialize and reproduce, and will still be able to detect threats with enough time to avoid injury. For this reason, we do not anticipate that the instances of PTS will result in changes in the number, distribution, or reproductive potential of fin whales in the North Atlantic.

For the up to 28 fin whales that are exposed to noise loud enough to result in TTS and disruption of behavior, but not loud enough to result in PTS, we expect normal behaviors to resume quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the longterm health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

We would not expect the TTS to span the entire communication or hearing range of fin whales given the frequencies produced by pile driving do not span entire hearing ranges for fin whales. Additionally, though the frequency range of TTS that fin whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. Before the TTS resolves, individual fin whales could be less efficient at locating conspecifics or have decreased ability to detect threats at long distances, but these animals are still expected to be able to locate conspecifics to socialize and reproduce, and will still be able to detect threats with enough time to avoid injury, including vessel strike.

The risks of TTS or masking affecting communication or threat avoidance are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). Also, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in fin whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters.

We have considered if pile driving noise may mask fin whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise, which in all cases would be less than 12 hours and likely far shorter (as explained in section 7.1). This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.

Fin whales in the WDA are migrating and may also forage. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 36fin whales (8 expected to experience PTS and behavioral disturbance plus 28 expected to experience

TTS and behavioral disturbance) exposed to harassing levels of noise will return to normal behavioral patterns after the exposure ends. As such, even if a fin whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event on a single day.

A single pile driving event will take approximately 7 to 9 hours; therefore, even in the event that the 29 fin whales expected to be exposed to impact pile driving noise were exposed to disturbing levels of noise for the entirety of a pile driving event, that disturbance would last approximately 7-9 hours. Vibratory pile driving may occur for up to 12 hours per day; in the event that the 7 fin whales expected to be exposed to vibratory pile driving noise were exposed to disturbing levels of noise for the entirety of a pile driving event, that disturbance would last no more than 12 hours. However, considering the area where noise will be elevated and the anticipated swim speed and behavioral response (avoidance), exposure is expected to be for considerably shorter period. An animal exhibiting the anticipated an avoidance response to pile driving noise would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area. As explained in section 7.1, during impact pile driving for foundation installation, the area with noise above the MMPA Level B harassment threshold extends approximately 2.2-4.5 km from the pile being driven while that area extends up to approximately 11 km during vibratory pile driving. As such, for a fin whale that was at the edge of the clearance zone when pile driving starts, we would expect a fin whale swimming at maximum speed (35 kph) would escape from the area with noise above 160 dB re 1uPa the noise in less than 10 minutes, at the normal cruising speed of 10 kph, it would take the animal less than 20 minutes to move out of the noisy area for impact pile driving and about an hour for vibratory pile driving.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). The energetic consequences of the evasive behavior and delay in resting are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated with each of these instances of disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which individuals will be exposed to elevated noise, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in significant costs to affected individuals.

As explained in section 7 of this Opinion, we determined that the adverse effects expected to result from the exposure of the 28 fin whales to noise below the Level A harassment threshold but above the Level B harassment threshold meet NMFS interim ESA definition of harassment.

The proposed action will result in the harassment, but not harm, of 28 individual fin whales; the only injury anticipated is of the up to 8 fin whales that are expected to experience PTS due to exposure to pile driving noise above the Level A harassment threshold. No other injury, and no harm, serious injury, or mortality is expected due to exposure to any aspect of the proposed action during the construction, operations, or decommissioning phases of the project.

Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of fin whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for fin whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project. Because we do not anticipate fitness consequences to individual fin whales to result from instances of TTS and behavioral disturbance due to acoustic stressors that we have determined meets the ESA definition of harassment but not harm, we do not expect reductions in overall reproduction, abundance, or distribution of the fin whale population in the North Atlantic or rangewide.

The proposed action will not result in any reduction in the abundance or reproduction of fin whales. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. There will be no change to the overall distribution of fin whales in the action area or throughout their range. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the fin whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action is not likely to affect the recovery potential of fin whales. In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2010 Recovery Plan for fin whales. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The 2010 Recovery Plan for fin whales included two criteria for consideration for reclassifying the species from endangered to threatened:

> 1. Given current and projected threats and environmental conditions, the fin whale population in each ocean basin in which it occurs (North Atlantic, North Pacific and Southern Hemisphere) satisfies the risk analysis standard for threatened status (has no more than a 1% chance of extinction in 100 years) and has at least 500 mature, reproductive individuals (consisting of at least 250 mature females and at least 250 mature males) in each ocean basin. Mature is defined as the number of individuals known, estimated, or inferred to be capable of reproduction. Any factors or circumstances that are thought to substantially contribute to a real risk of extinction that cannot be incorporated into a Population Viability Analysis will be carefully considered before downlisting takes place; and,
>
> 2. None of the known threats to fin whales are known to limit the continued growth of populations. Specifically, the factors in 4(a)(l) of the ESA are being or have been addressed: A) the present or threatened destruction, modification or curtailment of a species' habitat or range; B) overutilization for commercial, recreational or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors.

The proposed action will not result in any condition that impacts the time it will take to reach these goals or the likelihood that these goals will be met. This is because the proposed action will not affect the trend of the species or prevent or delay it from achieving an increasing population or otherwise affect the number of individuals or the species growth rate and will not affect the chance of extinction. The proposed action will not appreciably reduce the likelihood of recovery of fin whales.

The proposed action will not affect the abundance of fin whales; because no serious injury or mortality is anticipated, the project will not cause there to be fewer fin whales. The only effects to distribution of fin whales will be minor changes in the movements of up to 36 individuals exposed to pile driving noise above the Level B harassment threshold; there will be no changes in the distribution of the species throughout the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species.

Based on this analysis, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of fin whales in the wild by reducing the reproduction, numbers, or distribution of that species. These conclusions were made in consideration of the endangered status of fin whales, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of fin whales in the action area.

9.2.3 Sei Whales

The average spring 2010–2013 abundance estimate of 6,292 (CV=1.015) is considered the best available for the Nova Scotia stock of sei whales because it was derived from surveys covering the largest proportion of the range (Halifax, Nova Scotia to Florida), during the season when they are the most prevalent in U.S. waters (in spring), using only recent data (2010–2013), and correcting aerial survey data for availability bias (Hayes et al. 2022). However, as described in Hayes et al. 2022 (the most recent stock assessment report), there is considerable uncertainty in this estimate and there are insufficient data to determine population trends for the Nova Scotia stock of sei whales. As described in the *Status of the Species*, a robust estimate of worldwide abundance is not available. The most recent abundance estimate for the North Atlantic is an estimate of 10,300 whales in 1989 (Cattanach et al. 1993 as cited in (NMFS 2011a). In the North Pacific, an abundance estimate for the entire North Pacific population of sei whales is not available. However, in the western North Pacific, it is estimated that there are 35,000 sei whales (Cooke 2018a). In the eastern North Pacific (considered east of longitude 180^{o}), two stocks of sei whales occur in U.S. waters: Hawaii and Eastern North Pacific. Abundance estimates for the Hawaii stock are 391 sei whales (Nmin=204), and for Eastern North Pacific stock, 519 sei whales (Nmin=374) (Carretta et al. 2019a). In the Southern Hemisphere, recent abundance of sei whales is estimated at 9,800 to 12,000 whales.

Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of sei whales in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

As explained in section 7 of this Opinion, with the exception of 3 sei whales expected to experience PTS, the only adverse effects to sei whales expected to result from the Atlantic Shores project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment); we consider these adverse effects to occur at a level meeting NMFS's interim ESA definition of harassment. These adverse effects will be experienced by up to 9 individual sei whales as a result of exposure to noise from impact pile driving, and 6 sei whales as a result of exposure to noise from vibratory pile driving for sheet pile cofferdams, that is below the Level A harassment threshold but above the Level B harassment threshold. With the exception of 3 sei whales expected to experience PTS, no injury (auditory or other), serious injury or mortality is expected due to exposure to any effect of the proposed action during the construction, operations, or decommissioning phases of the project.

The distribution of sei whales overlaps with some parts of the vessel transit routes that will be used through the 40-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where sei whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a sei whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a sei whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

Based on the type of survey gear that will be deployed, we do not expect any effects to sei whales from the surveys of fishery resources planned by Atlantic Shores and considered as part of the proposed action. As such, capture or entanglement of a sei whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on sei whale prey. As sei whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (50 m or less) and any effects to sei whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to sei whales is very small (no more than 500 m from the sound source). Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough away to avoid it (less than 500 m), effects are insignificant.

PTS is permanent, meaning the effects of PTS last well beyond the duration of the proposed action and outside of the action area as animals migrate. As such, PTS has the potential to affect aspects of affected animal's life functions that do not overlap in time and space with the proposed action. As explained in section 7.1, we expect that the up to 3 sei whales estimated to be exposed to pile driving noise above the MMPA Level A harassment threshold would experience slight PTS, *i.e.* minor long-term or permanent degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (*i.e.* the low-frequency region below 2 kHz), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics, much less impact reproduction or survival (87 FR 64868; October 26, 2022). No severe hearing impairment or serious injury is expected because of the received levels of noise anticipated and the short duration of exposure. The PTS anticipated is considered a minor auditory injury and as such it constitutes take by harm under the ESA. As discussed previously in Section 7.1, permanent hearing impairment has the potential to affect individual whale survival and reproduction, although data are not readily available to evaluate how permanent hearing threshold shifts directly relate to individual whale fitness. The up to 3 sei whales that are harmed will also experience the physiological (i.e., stress) and behavioral effects described below for the animals that experience TTS. Our exposure and response analyses indicate that no more than 3 sei whales would experience PTS, but this PTS is expected to be minor. With this minor degree of PTS, we do not expect it to affect the individuals' overall health, reproductive capacity, or survival. The 3 sei whales could be less efficient at locating conspecifics or have decreased ability to detect threats at long distances, but these animals are still expected to be able to locate conspecifics to socialize and reproduce, and will still be able to detect threats with enough time to avoid injury. For this reason, we do not anticipate that the instances of PTS will result in changes in the number, distribution, or reproductive potential of sei whales in the North Atlantic.

Up to 15 sei whales are expected to be exposed to pile driving noise that will be loud enough to result in TTS or behavioral disturbance, inclusive of masking and stress that would meet the NMFS interim definition of ESA harassment but not harm. A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of sei whales to pile driving noise. However, even with these minimization measures in place, we expect 15 sei whales to experience TTS, temporary behavioral disturbance (up to 12 hours but likely far shorter), and associated temporary physiological stress during the construction period due to exposure to impact pile driving noise. As explained in the *Effects of the Action* section, all of these impacts, including TTS, are expected to be temporary with normal behaviors resuming quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the long-term health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 15 sei whales exposed to noise above the MMPA Level B harassment threshold would be likely to increase the risk of vessel strike or entanglement in fishing gear. We would not expect the TTS to span the entire communication or hearing range of sei whales given the frequencies produced by pile driving do not span entire hearing ranges for sei whales. Additionally, though the frequency range of TTS that sei whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. As such, we do not expect TTS to affect the ability of a sei whale to communicate with other sei whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats. As such, we do not expect masking to affect the ability of a sei whale to avoid a vessel. These risks are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). Also, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in sei whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters.

We have considered if pile driving noise may mask sei whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise, approximately 4-6 hours, but likely much less. This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.

Sei whales in the WDA are migrating and may forage in the WDA. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 15 sei whales exposed to harassing levels of noise will return to normal behavioral patterns after the exposure ends. As such, even if a sei whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event.

If an animal exhibits an avoidance response to pile driving noise, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area. As explained in section 7.1, during impact pile driving of foundations, the area with noise above the Level B harassment threshold extends approximately 2.2 to 4.5 km from the pile being driven while noise during vibratory pile installation/removal is expected to extend up to 11 km from the source. As such, a sei whale that was at the edge of the clearance zone when pile driving starts and that is swimming at maximum speed (55 kph) would escape from the area with noise above 160 dB re 1uPa the noise in less than 15 minutes, at the normal cruising speed of 10 kph, it would take the animal up to an hour to move out of the noisy area.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). The energetic consequences of the evasive behavior and delay in resting are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated with each of these instances of disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which individuals will be exposed to elevated noise, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in significant costs to affected individuals**.**

As described in greater detail in Section 7.1, we do not anticipate these instances of TTS and/or behavioral disturbance that meet the ESA definition of harassment but not harm to result in fitness consequences to the up to 25 individual sei whales to which this will occur. Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of sei whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for sei whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project. Because we do not anticipate fitness consequences to individual sei whales to result from the ESA harassment resulting from TTS, behavioral disturbance, and associated stress, due to exposure to acoustic stressors, we do not expect any reductions in overall reproduction, abundance, or distribution of the sei whale population in the North Atlantic or rangewide. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the sei whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action will not result in any reduction in the abundance or reproduction of sei whales. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. There will be no change to the overall distribution of sei whales in the action area or throughout their range.

The proposed action is also not expected to affect recovery potential of the species. In the 2021 5-Year Review for sei whales, NMFS concluded that the recovery criteria outlined in the sei whale recovery plan (NMFS 2011) do not reflect the best available and most up-to-date information on the biology of the species. Therefore, we have not relied on the reclassification criteria specifically when considering the effects of the Atlantic Shores action on the recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The Atlantic Shores project will not affect the status or trend of sei whales; this is because it will not result in the injury or mortality of any individuals or affect the ability of any individual to successfully reproduce or the ability of calves to grow to maturity. As such, the proposed action is not likely to affect the recovery potential of sei whales and is not likely to appreciably reduce the likelihood of recovery of North Atlantic right whales.

The proposed action will not affect the abundance of sei whales; this is, because no serious injury or mortality is anticipated, the project will not cause there to be fewer sei whales. The only effects to distribution of sei whales will be minor changes in the movements of up to 18 individuals exposed to pile driving noise; there will be no changes in the distribution of the species in the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species. Based on this analysis, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species. These conclusions were made in consideration of the endangered status of sei whales, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of sei whales in the action area.

9.2.4 Sperm Whales

As described in further detail in the Status of the Species, the most recent estimate indicated a global population of between 300,000 and 450,000 individuals (Whitehead 2009). The higher estimates may be approaching population sizes prior to commercial whaling, the reason for ESA listing. No other more recent rangewide abundance estimates are available for this species (Waring et al. 2015). Hayes et al. (2020) reports that several estimates from selected regions of sperm whale habitat exist for select time periods, however, at present there is no reliable estimate of total sperm whale abundance for the entire North Atlantic. Sightings have been almost exclusively in the continental shelf edge and continental slope areas; however, there has been little or no survey effort beyond the slope. The best recent abundance estimate for sperm whales in the North Atlantic is the sum of the 2016 surveys— 4,349 (CV=0.28) (Hayes et al. 2020).

Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of sperm whales in the overall action area over the life of this project, but given the shallow depths of the lease area, any change in distribution of sperm whales over time is not expected to result in any change in use of the lease area. We have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

As explained in the section 7 of this Opinion, the only adverse effects to sperm whales expected to result from the Atlantic Shores project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment) of up to 10 sperm whales that are exposed to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold; these adverse effects meet NMFS interim ESA definition of harassment. No injury (auditory or other), serious injury or mortality is expected due to exposure to any aspect of the proposed action during the construction, operations, or decommissioning phases of the project.

The distribution of sperm whales overlaps with some parts of the vessel transit routes that will be used through the 40-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where sperm whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a sperm whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a sperm whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

Based on the type of survey gear that will be deployed, any effects to sperm whales from the surveys of fishery resources planned by Atlantic Shores and considered as part of the proposed action are extremely unlikely to occur. As such, capture or entanglement of a sperm whale and any associated injury or mortality is not an expected outcome of the Atlantic Shores project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on sperm whale prey. Potential effects to echolocation are also insignificant. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (50 m or less) and any effects to sperm whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to sperm whales is very small (no more than 100 m from the sound source). Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough away to avoid it (less than 100 m), effects are insignificant.

No sperm whales are expected to be exposed to noise from pile driving that could result in PTS or any other injury. Only a small number of sperm whales (no more than 10) are expected to be exposed to pile driving that will be loud enough to result in TTS or behavioral disturbance that would meet the NMFS interim definition of ESA harassment. A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of sperm whales to pile driving noise. With these measures in place, we do not anticipate the exposure of any sperm whales to noise that could result in PTS, other injury, or mortality. However, even with these minimization measures in place, we expect up to 10 sperm whales to experience TTS, temporary behavioral disturbance and associated temporary physiological stress during the construction period due to exposure to impact pile driving noise. We have determined that the effects experienced by these 10 sperm whales meet the ESA definition of harassment, but not harm.

As explained in the *Effects of the Action* section, all of these impacts, including TTS, are expected to be temporary with normal behaviors resuming quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 10 sperm whales exposed to noise above the MMPA Level B harassment threshold would be likely to increase the risk of vessel strike or entanglement in fishing gear. We would not expect the TTS to span the entire communication or hearing range of sperm whales given the frequencies produced by pile driving do not span entire hearing ranges for sperm whales. Additionally, though the frequency range of TTS that sperm whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Atlantic Shores' pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. As such, we do not expect TTS to affect the ability of a sperm whale to communicate with other sperm whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats. As such, we do not expect masking to affect the ability of a sperm whale to avoid a vessel. These risks are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). In addition, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in sperm whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters.

We have considered if pile driving noise may mask sperm whale calls and could have effects on mother-calf communication and behavior. As noted in section 7.1, presence of mother-calf pairs is unlikely in the WDA. However, even if a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise, which in all cases would be no more than approximately 3 to 9 hours and is expected to be considerably shorter. This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance. We expect that sperm whales in the WDA are migrating. Foraging is unexpected due to the nearshore location and shallow depths. As such, disruption of foraging is not expected.

If an animal exhibits an avoidance response to pile driving noise, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the MMPA Level B harassment threshold would take a direct path to get outside of the noisy area. As explained in section 7.1, during impact pile driving of foundations, the area with noise above the MMPA Level B harassment threshold extends approximately 2-11 km from the pile being driven (considering foundation piles and sheet piles for cofferdams). As such, for a sperm whale that was at the edge of the clearance zone when pile driving starts we would expect a sperm whale swimming at maximum speed (45 kph) would escape from the area with noise above 160 dB re 1uPa the noise in about 20 minutes, but at normal cruise speed (5-15 kph), it would still take the animal less than an hour to move out of the noisy area.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). The energetic consequences of the evasive behavior and delay in resting are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated with each of these instances of disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which elevated noise will be experienced, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in significant costs to affected individuals**.**

As described in greater detail in Section 7.1, we do not anticipate these instances of TTS and behavioral disturbance that we have determined meet the ESA definition of harassment, but not harm, to result in fitness consequences to the up to 10 sperm whales to which this will occur. Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of sperm whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for sperm whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Atlantic Shores project.

We do not expect any injury, serious injury, or mortality of any sperm whale to result from the proposed action. We do not expect the action to affect the health of any sperm whale. We also do not anticipate fitness consequences to any individual sperm whales; that is, we do not expect any effects on any individual's ability to reproduce or generate viable offspring. Because we do not anticipate any reduction in fitness, we do not anticipate any future effects on reproductive success. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the sperm whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action is not likely to affect the recovery potential of sperm whales. In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2010 Recovery Plan for sperm whales. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The 2010 Recovery Plan contains downlisting and delisting criteria. As sperm whales are listed as endangered, we have considered whether the proposed action is likely to affect the likelihood that these criteria will be met or the time it takes to meet these criteria. The Plan states that sperm whales may be considered for reclassifying to threatened when all of the following have been met:

> 1. Given current and projected threats and environmental conditions, the sperm whale population in each ocean basin in which it occurs (Atlantic Ocean/Mediterranean Sea, Pacific Ocean, and Indian Ocean) satisfies the risk analysis standard for threatened status (has no more than a 1% chance of extinction in 100 years) and the global population has at least 1,500 mature, reproductive individuals (consisting of at least 250 mature females and at least 250 mature males in each ocean basin). Mature is defined as the number of individuals known, estimated, or inferred to be capable of reproduction. Any factors or circumstances that are thought to substantially contribute to a real risk of extinction that cannot be incorporated into a Population Viability Analysis will be carefully considered before downlisting takes place; and,
>
> 2. None of the known threats to sperm whales is known to limit the continued growth of populations. Specifically, the factors in 4(a)(l) of the ESA are being or have been addressed: A) the present or threatened destruction, modification or curtailment of a species' habitat or range; B) overutilization for commercial, recreational or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors.

The proposed action will not result in any condition that impacts the time it will take to reach these goals or the likelihood that these goals will be met. This is because the proposed action will not affect the trend of the species or prevent or delay it from achieving an increasing population or otherwise affect its growth rate and will not affect the chance of extinction. That is, the proposed action will not appreciably reduce the likelihood of recovery of sperm whales.

The proposed action will not affect the abundance of sperm whales; this is, because no serious injury or mortality is anticipated, the project will not cause there to be fewer sperm whales. The only effects to distribution of sperm whales will be minor changes in the movements of up to 10 individuals exposed to pile driving noise; there will be changes in the distribution of the species throughout the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species. For these reasons, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of sperm whales in the wild by reducing the reproduction, numbers, or distribution of that species. These conclusions were made in consideration of the endangered status of sperm whales, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of sperm whales in the action area.

10.0 CONCLUSION

After reviewing the current status of the ESA-listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is our biological opinion that the proposed action is likely to adversely affect but is not likely to jeopardize the continued existence of fin, sei, sperm, or North Atlantic right whales or the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, Kemp’s ridley or leatherback sea turtles, shortnose sturgeon, or any of the five DPSs of Atlantic sturgeon. The proposed action, specifically the transit of vessels to/from the NJWP, is likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon; these effects are included in the Environmental Baseline of this Opinion and there are no additional effects caused by this action. The proposed action is not likely to adversely affect blue whales, Rice’s whales, giant manta rays, hawksbill sea turtles, or gulf sturgeon. We have determined that the project will have no effect on oceanic whitetip sharks, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, any species of ESA listed corals, or critical habitat designated for the North Atlantic right whale, the Northwest Atlantic DPS of loggerhead sea turtles, or elkhorn, or staghorn corals.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species of fish or wildlife, respectively, without a permit or exemption. In the case of threatened species, section 4(d) of the ESA directs the agency to issue regulations it considers necessary and advisable for the conservation of the species and leaves it to the Secretary’s discretion whether and to what extent to extend the statutory 9(a)(1) ‘‘take’’ prohibitions to such species..

“Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm, as explained above, is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NMFS, as we have explained, has not yet defined "harass" under the ESA in regulation, but has issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFS PD 02-110-19). We considered NMFS' interim definition of harassment in evaluating whether the proposed activities are likely to result in harassment of ESA listed species. Incidental take statements serve a number of functions, including providing reinitiation triggers for all anticipated take, providing exemptions from the Section 9 prohibitions against take for endangered species and from any prohibition on take extended to threatened species by 4(d) regulations, and identifying reasonable and prudent measures with implementing terms and conditions that will minimize the impact of anticipated incidental take and monitor incidental take that occurs.

When an action will result in incidental take of ESA listed marine mammals, ESA section 7(b)(4) requires that such taking be authorized under the MMPA section 101(a)(5) before the Secretary can issue an Incidental Take Statement (ITS) for ESA listed marine mammals and that an ITS specify those measures that are necessary to comply with Section 101(a)(5) of the MMPA. Section 7(b)(4), section 7(o)(2), and ESA regulations provide that taking that is incidental to an otherwise lawful activity conducted by an action agency or applicant is not considered to be prohibited taking under the ESA if that activity is performed in compliance with the terms and conditions of this ITS, including those specified as necessary to comply with the MMPA, Section 101(a)(5). Accordingly, the terms of this ITS and the exemption from Section 9(a)(1) of the ES, and any 4(d) rule extending the Section 9(a)(1) prohibition on take to threatened species, become effective only upon the issuance of a final MMPA authorization to take the ESA-listed marine mammals identified here and the incorporation of its mitigation measures in this ITS. Absent such authorization and incorporation of its mitigation measures, this ITS is inoperative for ESA listed marine mammals. As described in this Opinion, Atlantic Shores Offshore Wind, LLC has applied for an MMPA ITA; a decision regarding issuance of the ITA is expected in early 2024 following issuance of the Record of Decision for the project.

The measures described below must be undertaken by the action agencies so that they become binding conditions for the exemption in section 7(o)(2) to apply. BOEM and other action agencies have a continuing duty to regulate the activity covered by this ITS. If one or more of them: (1) fails to assume and implement the terms and conditions, or (2) fails to require the project sponsor or their contractors to adhere to the terms and conditions of the ITS through enforceable terms and conditions that are included in any COP approval, grants, permits and/or contracts, the protective coverage of section 7(o)(2) may lapse. The protective coverage of section 7(o)(2) also may lapse if the project sponsor fails to comply with the terms and conditions and the minimization and mitigation measures included in the ITS as well as those described in the proposed action and set forth in Section 3 of this opinion. In order to monitor the impact of incidental take, BOEM, other action agencies, and Atlantic Shores must report the progress of the action and its impact on the species to us as specified in the ITS [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). As explained in the Effects of the Action section, we anticipate pile driving to result in the harassment of an identified number of North Atlantic right, fin, sperm, and sei whales and NWA DPS loggerhead, NA DPS green, Kemp's ridley, and leatherback sea turtles and to result in the harm of an identified number of fin and sei whales. We anticipate the serious injury or mortality of an identified number of NWA DPS loggerhead, NA DPS green, Kemp's ridley, and leatherback sea turtles due to vessel strikes during construction, operation, and decommissioning phases of the project. We also anticipate the capture and minor injury (i.e. meaning minor wounding for purposes of the ESA definition of take) of NWA DPS loggerhead, NA DPS green, and Kemp's ridley sea turtles and Atlantic sturgeon from the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs in trawl surveys of fisheries resources. With the exception of vessel strikes of up to 2 shortnose sturgeon and up to 7 Atlantic sturgeon from vessels transiting to/from the NJWP, Paulsboro Marine Terminal, and Repauno Terminal no other sources of incidental take of sturgeon are anticipated. There is no incidental take anticipated to result from EPA's proposed issuance of an Outer Continental Shelf Air Permit or NPDES permit or the USCG's proposed issuance of a Private Aids to Navigation (PATON) authorization. We anticipate no more than the amount and type of take described below to result from the construction, operation, and decommissioning of the Atlantic Shores project as proposed for approval by BOEM and pursuant to other permits, authorizations, and approvals by BSEE, USACE, and NMFS OPR.

Vessel Strike

We calculated the number of sea turtles likely to be struck by project vessels based on the anticipated increase in vessel traffic during the construction, operations, and decommissioning phases of the project. The following amount of incidental take is exempted over the 40-year life of the project, inclusive of construction, operations, and decommissioning of Atlantic Shores 1 and 2:

Species/DPS	Vessel Strike Mortality
Kemp's ridley sea turtle	3
Leatherback sea turtle	2
North Atlantic DPS green sea turtle	2
Northwest Atlantic DPS Loggerhead sea turtle	21

No take of any species of ESA listed whales resulting from vessel strike of any project vessels is anticipated or exempted.

The anticipated lethal take of Atlantic and shortnose sturgeon from vessels operating in the Delaware River transiting to/from the Paulsboro Marine Terminal, Repauno Terminal, and NJWP is anticipated as follows:

Port	Species/DPS	Vessel Strike Mortality
New Jersey Wind Port	NYB DPS Atlantic Sturgeon	2
	Chesapeake Bay, South Atlantic, OR Gulf of Maine DPS	1
	Shortnose sturgeon	1
Paulsboro Marine Terminal	NYB DPS Atlantic Sturgeon	2
	Shortnose sturgeon	1
Repauno Terminal	NYB DPS Atlantic Sturgeon	1
	Shortnose sturgeon	None

This take is exempted in those project's Biological Opinions and is included in the Environmental Baseline for this Opinion. No take of any other shortnose or Atlantic sturgeon as a result of vessel strike is anticipated or exempted.

Surveys of Fisheries Resources

We calculated the number of sea turtles and Atlantic sturgeon likely to be captured in trawl gear over the period that the surveys are planned based on available information on capture and injury/mortality rates in similar surveys. No take of any ESA listed whales in any fisheries surveys is anticipated or exempted.

The following amount of incidental take is exempted over the duration of the planned trawl survey (seven survey years):

Species/DPS	Trawl Surveys	
	Capture, Minor Injury	Serious Injury/Mortality
Gulf of Maine DPS Atlantic sturgeon	2	None
New York Bight DPS Atlantic sturgeon	47	None
Chesapeake Bay DPS Atlantic sturgeon	19	None
South Atlantic DPS Atlantic sturgeon	11	None
Carolina DPS Atlantic sturgeon	5	None
Kemp's ridley sea turtle	5	None
Leatherback sea turtle	None	None

North Atlantic DPS green sea turtle	1	None
Northwest Atlantic DPS Loggerhead sea turtle	7	None

If any additional surveys are planned or the survey duration is extended, consultation may need to be reinitiated.

Pile Driving

We calculated the number of whales and sea turtles expected to be harmed (Permanent Threshold Shift) or harassed (Temporary Threshold Shift and/or Behavioral Disturbance) due to exposure to pile driving noise during foundation installation based on the proposed construction scenario (i.e., 200 total WTG foundations, 1 Met-Tower, and up to 10 OSS foundations, meeting the isopleth distances identified for 10 dB attenuation). We also calculated the number of whales expected to be harassed (behavioral disturbance) due to exposure to pile driving noise during pile driving to support cable installation. For ESA listed whales, this is consistent with the amount of Level A and Level B harassment from impact pile driving for foundations and Level B harassment from vibratory installation and removal of sheet pile cofferdams that NMFS OPR is proposing to authorize through the MMPA ITA.

Species/DPS	Take due to Exposure to Pile Driving Noise	
	Impact Pile Driving – WT, OSS, and Met Tower Foundations	
	Harm/Injury (PTS)	Harassment (TTS/Behavior)
Fin whale	8 (3 Project 1; 5 Project 2)	21 (9 Project 1; 12 Project 2)
North Atlantic right whale	None	12 (4 Project 1; 8 Project 2)
Sei Whale	3 (1 Project 1; 2 Project 2)	9 (3 Project 1; 6 Project 2)
Sperm whale	None	6 (2 Project 1; 4 Project 2)
Kemp's ridley sea turtle	None	48
Leatherback sea turtle	None	25
North Atlantic DPS green sea turtle	None	2
Northwest Atlantic DPS Loggerhead sea turtle	None	816
Atlantic sturgeon – all five DPSs	None	None

Species	Take due to Exposure to Pile Driving Noise Pile Driving – Cable Landfall	
	Harm/Injury (PTS)	Harassment (TTS/Behavior)
Fin whale	None	7 (2 Atlantic City, 5 Monmouth)
North Atlantic right whale	None	8 (4 Atlantic City, 4 Monmouth)
Sei Whale	None	6 (3 Atlantic City, 3 Monmouth)

Species	Take due to Exposure to Pile Driving Noise Pile Driving – Cable Landfall	
	Harm/Injury (PTS)	Harassment (TTS/Behavior)
Sperm whale	None	4 (2 Atlantic City, 2 Monmouth)
Kemp's ridley sea turtle	None	None
Leatherback sea turtle	None	None
North Atlantic DPS green sea turtle	None	None
Northwest Atlantic DPS Loggerhead sea turtle	None	None
Atlantic sturgeon – all 5 DPSs	None	None

11.2 Effects of the Take

In this opinion, we determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of any ESA listed species under NMFS' jurisdiction.

11.3 Reasonable and Prudent Measures and Terms and Conditions

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action is likely to incidentally take individuals of ESA listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, necessary or appropriate reasonable and prudent measures, and terms and conditions to implement the measures, must be provided. Only incidental take specified in this ITS that would not occur but for the agency actions described in this Opinion, and any specified reasonable and prudent measures and terms and conditions identified in the ITS, are exempt from the taking prohibition of section 9(a), provided that, pursuant to section 7(o) of the ESA, such taking is in compliance with the terms and conditions of the ITS. This ITS for sea turtles and sturgeon is effective upon issuance, and the action agencies and applicant may receive the benefit of the sea turtle and sturgeon take exemption as long as they are complying with the applicable terms and conditions. This ITS for ESA listed marine mammals is not effective unless and until a final MMPA ITA is effective and the final mitigation measures in the ITA are determined to be consistent with the RPMs and terms and conditions in this ITS; the action agencies and applicant may receive the benefit of the ESA listed marine mammal take exemption as long as they are complying with the applicable terms and conditions in this ITS and the MMPA ITA.

Reasonable and prudent measures (RPMs) are measures to minimize the impact (i.e., amount or extent) of incidental take (50 C.F.R. §402.02). The RPMs determined to be necessary and appropriate and terms and conditions are specified as required by 50 CFR 402.14 (i)(1) to minimize the impact of incidental take of ESA listed species by the proposed action, to monitor document and report that incidental take, and to specify the procedures to be used to handle or dispose of any individuals of a species actually taken. The RPMs and their terms and conditions are nondiscretionary for the action agencies and applicant. The RPMs and terms and conditions must be undertaken by the appropriate Federal agency so that they become binding conditions of any COP approval, permit, other authorization, or approval for the exemption in section 7(o)(2) to apply.

The RPMs identified here are necessary and appropriate to minimize impacts of incidental take that might otherwise result from the proposed action, to monitor document and report incidental take that does occur, to specify the procedures to be used to handle or dispose of any individual listed species taken. Specifically, these RPMs and their implementing terms and conditions are designed to: minimize the exposure of ESA listed whales and sea turtles to pile driving noise. These RPMs and terms and conditions also require that all incidental take that occurs is documented and reported to NMFS in a timely manner and that any incidentally taken individual specimens are properly handled, resuscitated if necessary, transported for additional care or reporting, and/or returned to the sea.

Please note that these reasonable and prudent measures and terms and conditions are in addition to the minimization and avoidance measures that Atlantic Shores has included in its COP, the additional measures that BOEM has proposed to require as conditions of COP approval, and the mitigation measures identified in the proposed ITA issued by NMFS OPR, as all of these sources are considered part of the proposed action (see Section 3 above). All of the measures identified in Section 3 of this Opinion, including Appendix A and B, are considered part of the proposed action and not repeated here, yet must be complied with for the conclusions of this Opinion and for the take exemption to apply as the measures specified here rely on, supplement and clarify those measures and are necessary to minimize the impacts of incidental take. For example, the prohibition on impact pile driving from January 1 – April 30 is considered part of the proposed action, and it is not repeated here as an RPM or term and condition. The conditions identified in Section 3, inclusive of measures in Appendix A and B to minimize effects to sea turtles during vessel transits and to minimize effects to ESA listed species during survey/monitoring activities of fisheries resources are consistent with RPMs and Terms and Conditions issued by NMFS GARFO for actions similar to the Atlantic Shores project; we have not identified any additional RPMs and Terms and Conditions for those activities. In some cases, the RPMs and Terms and Conditions provide additional detail or clarity to measures that are part of the proposed action. A failure to implement the proposed action as identified in Section 3 of this Opinion would be a change in the action that may render the conclusions of this Opinion and the take exemption inapplicable to the activities carried out, and may necessitate reinitiation of consultation.

All of the RPMs and Terms and Conditions are reasonable and prudent and necessary and appropriate to minimize, monitor, document, and report the level of incidental take associated with the proposed action. None of the RPMs or the terms and conditions that implement them alter the basic design, location, scope, duration, or timing of the action and all of them involve only minor changes (50 CFR§ 402.14(i)(2)). A copy of this ITS must be on board all survey vessels and PSO platforms at all times.

Reasonable and Prudent Measures

We have determined the following RPMs are necessary and appropriate to minimize, monitor, document, and report the impacts of incidental take of threatened and endangered species that occurs during implementation of the proposed action:

1. Effects to ESA listed species must be minimized and monitored during pile driving.

2. Effects to ESA listed sturgeon resulting from project vessel operations in the Delaware Bay and Delaware River must be monitored and reported.
3. Effects to, or interactions with, ESA listed Atlantic sturgeon, whales, and sea turtles must be properly documented during all phases of the proposed action, and all incidental take must be reported to NMFS GARFO.
4. Plans must be prepared that describe the implementation of activities or monitoring protocols for which the details were not available at the time this consultation was completed. All required plans must be submitted to NMFS GARFO in advance of the applicable activity with sufficient time for review, comment, and concurrence.
5. BOEM, BSEE, NMFS OPR, and USACE must exercise their authorities to assess and ensure compliance with the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA listed species during activities described in this Opinion. On-site observation and inspection must be allowed to gather information on the implementation of measures, and the effectiveness of those measures, to minimize and monitor incidental take during activities described in this Opinion, including its Incidental Take Statement.

Terms and Conditions

To be exempt from the prohibitions of Section 9 of the ESA, the federal action agencies (BOEM, BSEE, USACE, and NMFS OPR, each consistent with their own legal authority) – and Atlantic Shores (the lessee and applicant), must comply with the following terms and conditions (T&C), which implement the RPMs above. These include the take minimization, monitoring, and reporting measures required by the Section 7 regulations (50 C.F.R. §402.14(i)). These terms and conditions are non-discretionary; that is, if the Federal agencies and/or Atlantic Shores fail to ensure compliance with these terms and conditions and the RPMs they implement, the protective coverage of Section 7(o)(2) may lapse.

1. To implement the requirements of RPM 1 for ESA listed whales, Atlantic Shores must comply with the measures specified in the proposed ITA (which are incorporated into the proposed action) as modified or supplemented in the final MMPA ITA, to minimize effects of pile driving and other activities on ESA listed whales. To facilitate implementation of this requirement:
    a. BOEM must require, through an enforceable condition of their approval of Atlantic Shores' Construction and Operations Plan, Atlantic Shores to comply with any measures included in the proposed ITA, which already have been incorporated into the proposed action, as modified or supplemented by the final MMPA ITA.
    b. NMFS OPR must ensure compliance with all mitigation measures as prescribed in the final ITA. We expect this will be carried out through NMFS OPR's review of plans and monitoring reports, including interim and final SFV reports, submitted by Atlantic Shores over the life of the MMPA ITA and taking any responsive action within its statutory and regulatory authority it deems necessary to ensure compliance with all final ITA mitigation measures based on the foregoing review.

c. The USACE must review the final MMPA ITA as issued by NMFS OPR and determine if an amendment or revision is necessary to the permit issued to Atlantic Shores by USACE to incorporate any new or revised measures for pile driving or related activities addressed in the USACE permit, to ensure compliance with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which have been incorporated into the proposed action; and, if necessary, exercise its regulatory authority to make appropriate amendments or revisions.

2. To implement the requirements of RPM 1, the following measures related to sound field verification (SFV) for impact pile driving carried out for WTG, OSS, and Met Tower foundation installation must be implemented by BOEM, BSEE, USACE, and/or Atlantic Shores. The purpose of SFV and the steps outlined here are to ensure that Atlantic Shores does not exceed the distances to the auditory injury (i.e. harm) or behavioral harassment threshold (Level A and Level B harassment respectively) for ESA listed marine mammals, the harm or behavioral harassment thresholds for sea turtles, or the harm or behavioral disturbance thresholds for Atlantic sturgeon. These thresholds, identified and described in this Opinion, underpin the effects analysis, exposure analysis and our determination of the amount and extent of incidental take anticipated and exempted in this ITS, including any determination that no incidental take is anticipated (i.e., for Atlantic sturgeon). The measures outlined here are based on the expectation that Atlantic Shore's initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation) but, if that is not the case, provide a step-wise approach for modifying operations and/or modifying or adding sound attenuation measures that can reasonably be expected to avoid exceeding those thresholds prior to the next pile being driven.

   a. BOEM, BSEE, and USACE must require, and Atlantic Shores must implement, thorough SFV on at least the first three monopiles installed each calendar year (see also T&C 10.d. below) in accordance with the additional requirements specified here. Subsequent thorough SFV measurements would also be required should larger piles be installed or if additional piles are driven that are anticipated to produce louder sound fields than those previously measured (e.g., higher hammer energy, greater number of strikes, etc.). If any of the SFV measurements from any pile indicate that the distance to any isopleth of concern for any species is greater than those modeled assuming 10 dB attenuation (see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29)[59], before the next pile is installed Atlantic Shores must implement the following measures as applicable:

      i. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances (e.g., if the pile was installed with a single bubble curtain and a near field sound attenuation device, add a second bubble curtain or if the

[59] As noted in section 7.1 of the Opinion, when these tables reference exposure ranges, SFV results will be compared to the appropriate corresponding distances calculated for acoustic ranges as reported in Weirathmueller et al. 2023.

pile was installed with a double bubble curtain without a near field sound attenuation device, add a nearfield noise attenuation device; adjust hammer operations; adjust noise attenuation system to improve performance); provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 1 then additional measures must be deployed before installing pile 2). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving Atlantic Shores' proposal and request for concurrence.

ii. If any of the SFV measurements indicate that the distances to level A thresholds for ESA listed whales (peak or cumulative) or PTS peak or cumulative thresholds for sea turtles are greater than the modeled distances (assuming 10 dB attenuation, see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), the clearance and shutdown zones (see Table 11.1) for subsequent piles must be increased so that they are at least the size of the distances to those thresholds as indicated by SFV (e.g., if threshold distances are exceeded on pile 1 then the clearance and shutdown zones for pile 2 must be expanded). For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms/vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; Atlantic Shores must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number of PSOs and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones.

iii. If after implementation of 2.a.i, any subsequent SFV measurements indicate that the distances to any identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation(see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), Atlantic Shores must identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 2 then additional measures must be deployed before installing pile 3). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving Atlantic Shores' proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 2.b.ii.

iv. Following installation of the pile with additional, modified, and/or alternative noise attenuation measures or operational changes required by 2.a.iii, if SFV results indicate that any isopleths of concern are still greater than those modeled assuming 10 dB attenuation, before any additional piles can be installed, Atlantic Shores must identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 3 then additional measures must be deployed before installing pile 4). Following concurrence from NMFS GARFO, BOEM, BSEE, and USACE must require and Atlantic Shores must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 2.a.ii. Additionally, BOEM, BSEE, and USACE must require and Atlantic Shores must continue SFV for two additional piles with enhanced sound attenuation measures and submit the interim reports as required above (for a total of at least three piles with consistent noise attenuation measures).

v. If no additional measures or modifications are identified for implementation, or if the SFV required by 2.a.iv indicates that the distance to any isopleths of concerns for any ESA listed species are still greater than those modeled assuming 10 dB attenuation, NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation.

vi. Following installation of the pile with additional, alternative, or modified noise attenuation measures/operational changes required by 2.a.iii or 2.a.iv, if SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation (see

Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), SFV must be conducted on two additional piles (for a total of at least three piles with consistent noise attenuation measures). If the SFV results from all three of those piles are within the distances to isopleths of concern modeled assuming 10 dB attenuation, then BOEM, BSEE, and USACE must require, and Atlantic Shores must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes: BOEM, BSEE, USACE and/or Atlantic Shores can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 11.1) or Atlantic Shores can continue with the expanded clearance and shutdown zones with additional PSOs.

b. BOEM, BSEE, and USACE must require, and Atlantic Shores must implement thorough Sound Field Verification (SFV) on all pin piles associated with installation of the first three pile driven jacket foundations installed in a calendar year (see also T&C 10.d. below) in accordance with the additional requirements specified here. Subsequent thorough SFV measurements would also be required should larger piles be installed or if additional piles are driven that are anticipated to produce louder sound fields than those previously measured (e.g., higher hammer energy, greater number of strikes, etc.). If any of the SFV measurements from any pile indicate that the distance to any isopleth of concern is greater than those modeled assuming 10 dB attenuation (see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23,)[60], before the next pile is installed Atlantic Shores must implement the following measures as applicable:

   i. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances (e.g., if the foundation was installed with a single bubble curtain and a near field sound attenuation device, add a second bubble curtain or if the pile was installed with a double bubble curtain without a near field sound attenuation device, add a nearfield noise attenuation device; adjust hammer operations; adjust noise attenuation system to improve performance); provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 1 then additional measures must be deployed before installing pile 2). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later

[60] As noted in section 7.1 of the Opinion, when these tables reference exposure ranges, SFV results will be compared to the appropriate corresponding distances calculated for acoustic ranges as reported in Weirathmueller et al. 2023.

than two business days after receiving Atlantic Shores' proposal and request for concurrence.

ii. If any of the SFV measurements indicate that the distances to level A thresholds for ESA listed whales (peak or cumulative) or PTS peak or cumulative thresholds for sea turtles are greater than the modeled distances (assuming 10 dB attenuation, see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), the clearance and shutdown zones (see Table 11.1) for subsequent jacket foundations must be increased so that they are at least the size of the distances to those thresholds as indicated by SFV (e.g., if threshold distances are exceeded on jacket foundation 1 then the clearance and shutdown zones for foundation 2 must be expanded). For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms/vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; Atlantic Shores must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number of PSOs and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones.

iii. If after implementation of 2.b.i, any subsequent SFV measurements indicate that the distances to any identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation (see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), Atlantic Shores must identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent jacket foundations that are installed (e.g., if threshold distances are exceeded on jacket foundation 2 then additional measures must be deployed before installing foundation 3). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving Atlantic Shores' proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 2.b.ii.

iv. Following installation of the foundation with additional, modified, and/or alternative noise attenuation measures or operational changes required by 2.b.iii, if SFV results indicate that any isopleths of concern are still greater than those modeled assuming 10 dB attenuation, before any additional piles can be installed, Atlantic Shores must identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide a written explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are exceeded on jacket foundation 3 then additional measures must be deployed before installing foundation 4). Following concurrence from NMFS GARFO, BOEM, BSEE, and USACE must require and Atlantic Shores must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 2.b.ii. Additionally, BOEM, BSEE, and USACE must require and Atlantic Shores must continue SFV for two additional piles with enhanced sound attenuation measures and submit the interim reports as required above (for a total of at least three piles with consistent noise attenuation measures).

v. If no additional measures or modifications are identified for implementation, or if the SFV required by 2.b.iv indicates that the distance to any isopleths of concerns for any ESA listed species are still greater than those modeled assuming 10 dB attenuation, NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation.

vi. Following installation of the jacket foundation with additional, alternative, or modified noise attenuation measures/operational changes required by 2.b.iii or 2.b.iv, if SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation (see Tables 7.1.8, 7.1.9, 7.1.10, 7.1.23, 7.1.29), SFV must be conducted on two additional jacket foundations (for a total of at least three jacket foundations with consistent noise attenuation measures). If the SFV results from all three of those foundations are within the distances to isopleths of concern modeled assuming 10 dB attenuation, then BOEM, BSEE, and USACE must require, and Atlantic Shores must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes: BOEM, BSEE, USACE and/or Atlantic Shores can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 11.1) or Atlantic Shores can continue with the expanded clearance and shutdown zones with additional PSOs.

c. Abbreviated SFV Monitoring (consisting of a single acoustic recorder, consisting of a bottom and midwater hydrophone, placed at an appropriate distance from the pile) must be performed on all pile driven foundation installations for which the complete/thorough SFV monitoring outlined in 2a and 2b is not carried out. Abbreviated SFV is intended to provide a means of monitoring attenuated sound produced during pile driving and to provide an indication of whether sound is louder than anticipated, which can allow for adjustments to be made to noise attenuation measures or pile driving operations. Results of abbreviated SFV monitoring must be included in the weekly pile driving reports. If results of abbreviated SFV monitoring indicate that distances to the identified Level A and Level B harassment thresholds for whales or distances to injury or behavioral disturbance distances for sea turtles or Atlantic sturgeon may have been exceeded during the pile driving event, Atlantic Shores must notify NMFS GARFO as soon as possible after receiving such results, and in the weekly report must include an explanation of suspected or identified factors that contributed to the potential exceedance and corrective actions that were taken, or planned to be taken, to avoid potential exceedance on subsequent piles. Additional action may include adjustments or additions to the noise attenuation system or pile driving operations and/or additional thorough SFV monitoring. BOEM, BSEE, USACE, and Atlantic Shores must meet and/or discuss with NMFS GARFO within two business days of Atlantic Shores' submission of a report that includes an exceedance to discuss if any additional action is necessary, unless an alternative timeline is agreed to by NMFS GARFO.

d. Atlantic Shores must inspect and carry out appropriate maintenance on the noise attenuation system prior to every pile driving event (i.e., for each pile driven foundation) and prepare and submit a Noise Attenuation System (NAS) inspection/performance report. For piles for which thorough SFV is carried out, this report must be submitted as soon as it is available, but no later than when the interim SFV report is submitted for the respective pile. Performance reports for all subsequent piles must be submitted with the weekly pile driving reports. All reports must be submitted by email to nmfs.gar.incidental-take@noaa.gov.

    i. Performance reports for each bubble curtain deployed must include water depth, current speed and direction, wind speed and direction, bubble curtain deployment/retrieval date and time, bubble curtain hose length, bubble curtain radius (distance from pile), diameter of holes and hole spacing, air supply hose length, compressor type (including rated Cubic Feet per Minute (CFM) and model number), number of operational compressors, performance data from each compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times), free air delivery (m^3/min), total hose air volume (m^3/(min m)), schematic of GPS waypoints during hose laying, maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and timing of those tests, and the length of time the bubble curtain was on the seafloor prior to foundation installation. Additionally, the report must include any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure. The report may also include any relevant video and/or photographs of the bubble curtain(s) operating during all pile driving.

3. To implement the requirements of RPM 2, the following conditions must be implemented:

    a. BOEM, BSEE, and/or USACE must require that Atlantic Shores document and report project vessel trips to/from ports in the Delaware River, including the number of vessel calls to the Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno. This must be included in the monthly project reports submitted to NMFS GARFO over the life of the project (see Term and Condition 6.g. below). An annual summary of project vessel calls to these ports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and the USACE Philadelphia District (NAPRegulatory@usace.army.mil).

    b. BOEM, BSEE, and/or USACE must ensure that Atlantic Shores is aware of and complies with the following reporting requirements for all project vessels transiting to/from ports in the Delaware River:

        i. Report any sturgeon observed with injuries or mortalities along the transit route in the Delaware Bay, Delaware River, or in the vicinity of the port that the vessel is calling on to NMFS within 24 hours by submitting the form available at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null to nmfs.gar.incidental-take@noaa.gov.

        ii. Collect any dead sturgeon observed in the vicinity of the port that the vessel is calling on and hold in cold storage until proper disposal procedures are discussed with NMFS GARFO.

        iii. Complete procedures for genetic sampling of any collected dead Atlantic sturgeon that are over 75 cm. More information on collecting and submitting genetic samples is included in Term and Condition 6a below.

These requirements and instructions are consistent with the requirements of the RPMs and Terms and Conditions of the 2022 New Jersey Wind Port Opinion and the 2023 Paulsboro Opinion. As explained in section 7.2, the 2017 Repauno Opinion did not exempt any incidental take and therefore had no RPMs or Terms and Conditions.

4. To implement the requirements of RPM 3, Atlantic Shores must file a report with NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (via TIMSWeb and notification email to protectedspecies@bsee.gov) in the event that any ESA listed species is observed within the identified shutdown zone during active pile driving. This report must be filed within 48 hours of the incident and include the following: duration of pile driving prior to the detection of the animal(s), location of PSOs and any factors that impaired visibility or detection ability, time of first and last detection of the animal(s), distance of animal at first detection, closest point of approach of animal to pile, behavioral observations of the animal(s), time the PSO called for shutdown, hammer log (number of strikes, hammer

energy), time the pile driving began and stopped, and any measures implemented (e.g., reduced hammer energy) prior to shutdown. If shutdown was determined not to be feasible, the report must include an explanation for that determination and the measures that were implemented (e.g., reduced hammer energy).

5. To implement the requirements of RPM 3, BOEM, BSEE, USACE, and Atlantic Shores must implement the following reporting requirements necessary to document the amount or extent of incidental take that occurs during all phases of the proposed action:

    a. All observations or interactions with sea turtles or sturgeon that occur during the fisheries monitoring surveys must be reported within 48 hours to NMFS GARFO Protected Resources Division by email (nmfs.gar.incidental-take@noaa.gov). Take reports should reference the Atlantic Shores project and include the Take Report Form available on NMFS webpage (https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null). Reports of Atlantic sturgeon take must include a statement as to whether a fin clip sample for genetic sampling was taken. Fin clip samples are required in all cases of interactions and handling of Atlantic sturgeon to document the DPS of origin; the only exception to this requirement is when additional handling of the sturgeon would result in an imminent risk of injury to the fish or the survey personnel handling the fish: we expect such incidents to be limited to capture and handling of sturgeon in extreme weather. Instructions for fin clips and associated metadata are available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic, under the "Sturgeon Genetics Sampling" heading.

    b. If a North Atlantic right whale is observed at any time by PSOs or project personnel, Atlantic Shores must ensure the sighting is immediately reported to NMFS. If immediate reporting is not possible, the report must be made within 24 hours of the sighting.

        i. The report must be made to the appropriate geographic reporting line:

            - If in the Northeast Region (ME to VA/NC border) call (866-755-6622).
            - If in the Southeast Region (NC to FL) call (877-WHALE-HELP or 877-942-5343).
            - If calling the hotline is not possible, reports can also be made to the U.S. Coast Guard via channel 16 or through the WhaleAlert app (http://www.whalealert.org/).

    The sighting report must include the time (note time format, e.g., UTC, EST), date, and location (latitude/longitude in decimal degrees) of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), lease area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information.

ii. If a North Atlantic right whale is detected at any time by PSOs/PAM Operators via PAM, Atlantic Shores must ensure the detection is reported as soon as possible and no longer than 24 hours after the detection to NMFS via the 24-hour North Atlantic right whale Detection Template (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates). Calling the hotline is not necessary when reporting PAM detections via the template.

iii. A summary report must be sent within 24 hours to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), NMFS OPR (PR.ITP.MonitoringReports@noaa.gov), and NMFS-NEFSC (ne.rw.survey@noaa.gov) with the above information and confirmation the sighting/detection was reported to the respective hotline, the vessel/platform from which the sighting/detection was made, activity the vessel/platform was engaged in at time of sighting/detection, project construction and/or survey activity ongoing at time of sighting/detection (e.g., pile driving, cable installation, HRG survey), distance from vessel/platform to animal at time of initial sighting/detection, closest point of approach of whale to vessel/platform, vessel speed, and any mitigation actions taken in response to the sighting.

c. In the event of a suspected or confirmed vessel strike of any ESA listed species (e.g. marine mammal, sea turtle, listed fish) by any vessel associated with the Project or other means by which project activities caused a non-auditory injury or death of a ESA listed species, Atlantic Shores must immediately report the incident to NMFS. If in the Greater Atlantic Region (ME-VA), call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL), call the NMFS Southeast Stranding Hotline (877-942-5343). As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Separately, Atlantic Shores must immediately report the incident to NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov)*, and if in the Southeast region (NC-FL), also to NMFS SERO (*secmammalreports@noaa.gov*) The report must include: (A) Time, date, and location (coordinates) of the incident; (B) Species identification (if known) or description of the animal(s) involved (i.e., identifiable features including animal color, presence of dorsal fin, body shape and size); (C) Vessel strike reporter information (name, affiliation, email for person completing the report); (D) Vessel strike witness (if different than reporter) information (name, affiliation, phone number, platform for person witnessing the event); (E) Vessel name and/or MMSI number; (F) Vessel size and motor configuration (inboard, outboard, jet propulsion); (G) Vessel's speed leading up to and during the incident; (H) Vessel's course/heading and what operations were being conducted (if applicable); (I) Part of vessel that struck whale (if known); (J) Vessel damage notes; (K) Status of all sound sources in use; (L) If animal was seen before strike event; (M) behavior of animal before strike event; (N) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; (O) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; (P) Estimated (or actual, if known) size and length of animal that was struck; (Q) Description of the behavior of the marine mammal immediately preceding and following the strike; (R) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; (S) Other animal details if known (e.g., length, sex, age class); (T) Behavior or estimated fate of the animal post-strike (*e.g.*, dead, injured but alive, injured and moving, external visible wounds (linear wounds, propeller wounds, non-cutting blunt-force trauma wounds), blood or tissue observed in the water, status unknown, disappeared); (U) To the extent practicable, photographs or video footage of the animal(s); and (V) Any additional notes the witness may have from the interaction. For any numerical values provided (i.e., location, animal length, vessel length etc.), please provide if values are actual or estimated.

d. In the event that personnel involved in the Project discover a stranded, entangled, injured, or dead ESA listed species (e.g. marine mammal, sea turtle, listed fish), the Atlantic Shores must immediately report the observation to NMFS. If in the Greater Atlantic Region (ME-VA) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL) call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, Atlantic Shores must report the incident, if in the Greater Atlantic region (ME to VA) to GARFO (nmfs.gar.incidental-take@noaa.gov) or if in the Southeast region (NC-FL) to NMFS SERO (secmammalreports@noaa.gov) as soon as feasible. As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Note, the stranding hotline may request the report be sent to the local stranding network response team. Reports of listed fish should only be sent to nmfs.gar.incidental-take@noaa.gov. The report must include: (A) Contact information (name, phone number, etc.), time, date, and location (coordinates) of the first discovery (and updated location information if known and applicable); (B) Species identification (if known) or description of the animal(s) involved; (C) Condition of the animal(s) (including carcass condition if the animal is dead); (D) Observed behaviors of the animal(s), if alive; (E) If available, photographs or video footage of the animal(s); and (F) General circumstances under which the animal was discovered. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles.

e. Atlantic Shores must compile and submit weekly reports during each month that foundation pile driving occurs that document the pile ID, type of pile, pile diameter, start and finish time of each pile driving event, hammer log (number of strikes, max hammer energy, duration of piling) per pile, any changes to noise attenuation systems and/or hammer schedule, details on the deployment of PSOs and PAM operators, including the start and stop time of associated observation periods by the PSOs and PAM Operators, and a record of all observations/detections of marine mammals and sea turtles including time (UTC) of sighting/detection, species ID, behavior, distance (meters) from vessel to animal at time of sighting/detection (meters), animal distance (meters) from pile installation vessel, vessel/project activity at time of sighting/detection, platform/vessel name, and mitigation measures taken (if any) and reason. Sightings/detections during pile driving activities (clearance, active pile driving, post-pile driving) and all other (transit, opportunistic, etc.) sightings/detection must be reported and identified as such. These weekly reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE by Atlantic Shores or the PSO providers and can consist of QA/QC'd raw data. Weekly reports are due on Wednesday for the activities occurring the previous week (Sunday – Saturday, local time).

f. Starting in the first month that in-water activities occur (e.g., cable installation, fisheries surveys), Atlantic Shores must compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including dates and location of any fisheries surveys carried out, vessel transits (name, type of vessel, number of transits, vessel activity, and route (origin and destination) (this includes transits from all ports, foreign and domestic)), cable installation activities (including sea to shore transition), number of piles installed and pile IDs, and all sightings/detections of ESA listed whales, sea turtles, and sturgeon, inclusive of any mitigation measures taken as a result of those observations. Sightings/detections must include species ID, time, date, initial detection distance, vessel/platform name, vessel activity, vessel speed, bearing to animal, project activity, and if any mitigation measures taken. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and are due on the 15th of the month for the previous month.

g. Atlantic Shores must submit to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) an annual report describing all activities carried out to implement their Fisheries Research and Monitoring Plan. This report must include a summary of all activities conducted, the dates and locations of all fisheries surveys, including location and duration for all trawl surveys summarized by month, number of vessel transits inclusive of port of origin and destination, and a summary table of any observations and captures of ESA listed species during these surveys. The report must also summarize all acoustic telemetry and benthic monitoring activities that occurred, inclusive of vessel transits. Each annual report is due by February 15 (i.e., the report for 2024 activities is due by February 15, 2025).

h. BOEM, BSEE, and/or Atlantic Shores must submit full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction within 90 calendar days after pile-driving has ended. Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at *https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*. BOEM, BSEE, and/or Atlantic Shores must submit the full acoustic recordings from all the real-time hydrophones to the National Centers for

Environmental Information (NCEI) for archiving within 90 calendar days after pile-driving has ended and instruments have been pulled from the water. Archiving guidelines outlined here (https://www.ncei.noaa.gov/products/passive-acoustic-data#tab-3561) must be followed. Confirmation of both submittals must be sent to NMFS GARFO.

6. To implement the requirements of RPM 3 and to facilitate monitoring of the incidental take exemption for sea turtles, BOEM, BSEE, USACE, and NMFS must meet twice annually to review sea turtle observation records. These meetings/conference calls will be held in September (to review observations through August of that year) and December (to review observations from September to November) and will use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations.

7. To implement the requirements of RPM 3, within 10 business days of BOEM, BSEE, and/or USACE obtaining updated information on project plans (i.e., as obtained through a relevant Facility Design Report (FDR) and/or Fabrication and Installation Report (FIR), or other submission), BOEM, BSEE, and/or USACE must provide NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) with the following information: number, size, and type of foundations to be installed to support wind turbine generators, offshore substations, and met towers for each project; confirmation of installation method for the sea to shore transition (e.g., sheet pile cofferdam), the proposed construction schedule (i.e., months when pile driving is planned) for each project, and any available updates on anticipated vessel transit routes (e.g., any changes to the ports identified for use by project vessels) that will be used by project vessels. NMFS GARFO will review this information and request a meeting with BOEM, BSEE, and USACE if there is any indication that there are changes to the proposed action that would cause an effect to listed species or critical habitat that was not considered in this Opinion, including the amount or extent of predicted take, such that any potential trigger for reinitiation of consultation can be discussed with the relevant action agencies.

8. To implement RPM 3 for trawl surveys:

    a. At least one of the survey staff onboard the trawl survey vessels must have completed NMFS Northeast Fisheries Observer Program (NEFOP) training within the last 5 years or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon); documentation of training must be submitted to NMFS GARFO at least 7 calendar days prior to the start of the trawl surveys and at any later time that a different NEFOP trained observer is deployed on the survey.

    b. If Atlantic Shores will deploy non-NEFOP trained survey personnel in lieu of NEFOP-trained observers, BOEM, BSEE, and/or Atlantic Shores must submit a plan to NMFS describing the training that will be provided to those survey observers. This Observer Training Plan for Trawl Surveys must be submitted as soon as possible after issuance of this Opinion but no later than 15 calendar days prior to the start of trawl surveys for which a non-NEFOP trained observer will be deployed. BOEM, BSEE, and Atlantic Shores must obtain NMFS GARFO's concurrence with this plan prior to the start of any such trawl surveys. This plan must include a description of the elements of the training (i.e., curriculum, virtual or hands on, etc.) and identify who will carry out the training and their qualifications. Once the training is complete, confirmation of the training and a list of trained survey staff must be submitted to NMFS; this list must be updated if additional staff are trained for future surveys. In all cases, a list of trained survey staff must be submitted to NMFS at least one business day prior to the beginning of the survey.

9. To implement RPM 4, the plans identified below must be submitted to NMFS GARFO at nmfs.gar.incidental-take@noaa.gov by BOEM, BSEE, and/or Atlantic Shores. Any of the identified plans can be combined such that a single submitted plan addresses multiple requirements provided that the plan clearly identifies which requirements it is addressing. For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and Atlantic Shores, including a determination as to whether the plan is consistent with the requirements outlined in this ITS and/or in Section 3 of this Opinion. If the plan is determined to be inconsistent with these requirements (e.g., if required information is missing), BOEM, BSEE and/or Atlantic Shores must resubmit a modified plan that addresses the identified issues within 30 days of the receipt of the comments but at least 15 calendar days before the start of the associated activity; at that time, BOEM, BSEE and NMFS GARFO will discuss a timeline for review and approval of the modified plan. If further revisions are necessary, at all times, NMFS GARFO, BOEM, and BSEE will be provided at least three business days for review and whenever possible, NMFS GARFO, BOEM, and BSEE will aim to provide responses within four business days. BOEM, BSEE and Atlantic Shores must receive NMFS GARFO's concurrence with these plans before the identified activity is carried out:

    a. Marine Mammal and Sea Turtle Monitoring Plan – Foundation Pile Driving (WTG, OSS, and Met Tower). BOEM, BSEE, and/or Atlantic Shores must submit this Plan to NMFS GARFO at least 180 calendar days before any pile driving for foundation installation is planned. BOEM, BSEE, and/or Atlantic Shores must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any pile driving for foundation installation. The Plan(s) must include: a description of how all relevant mitigation and monitoring requirements contained in the incidental take statement and those included as part of the proposed action, will be implemented; a pile driving installation summary and sequence of events; a description of all training protocols for all project personnel (PSOs, PAM Operators, trained crew lookouts, etc.); a description of all monitoring equipment and evidence (i.e., manufacturer's specifications, reports, testing) that it can be used to effectively monitor and detect ESA listed marine mammals and sea turtles in the identified clearance and shutdown zones (i.e., field data demonstrating reliable and consistent ability to detect ESA listed large whales and sea turtles at the relevant distances in the conditions planned for use); communications and reporting details; and PSO monitoring and mitigation protocols (including number and location of PSOs) for effective observation and documentation of sea turtles and ESA listed marine mammals during all pile driving events. The Plan(s) must demonstrate sufficient PSO and PAM Operator staffing (in accordance with watch shifts), PSO and PAM Operator schedules, and contingency plans for instances if additional PSOs and PAM Operators are required. The Plan must detail all plans and procedures for sound attenuation, including procedures for adjusting the noise attenuation system(s) and available contingency noise attenuation measures/systems if distances to modeled isopleths of concern are exceeded during SFV. The plan must also describe how Atlantic Shores would determine the number of sea turtles exposed to noise above the 175 dB harassment threshold during impact pile driving foundations and how Atlantic Shores would determine the number of ESA listed whales exposed to noise above the Level B harassment threshold during impact pile driving of foundations.

b. Reduced Visibility Monitoring Plan/Nighttime Pile Driving Monitoring Plan. BOEM, BSEE, and/or Atlantic Shores must submit this Plan or Plans (if separate Daytime Reduced Visibility and Nighttime Monitoring Plans are prepared) to NMFS GARFO at least 180 calendar days before impact pile driving is planned to begin. This plan can be included as a sub-section of the Marine Mammal and Sea Turtle Monitoring Plan addressed above. BOEM, BSEE, and Atlantic Shores must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of impact pile driving. This Plan(s) must contain a thorough description of how Atlantic Shores will monitor pile driving activities during reduced visibility conditions (e.g. rain, fog) and at night, including proof of the efficacy of monitoring devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices NVDs, spotlights) in detecting ESA listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones (1,500 m) can be effectively and reliably monitored. The Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdown zones under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. If the plan does not include a full description of the proposed technology, monitoring methodology, and data demonstrating to NMFS GARFO's satisfaction that marine mammals and sea turtles can reliably and effectively be detected within the clearance and shutdown zones for monopiles before and during impact pile driving, nighttime pile driving (unless a pile was initiated 1.5 hours prior to civil sunset) may not occur. Additionally, this Plan must contain a thorough description of how Atlantic Shores will monitor pile driving activities during daytime when unexpected changes to lighting or weather occur during pile driving that prevent visual monitoring of the full extent of the clearance and shutdown zones.

c. Passive Acoustic Monitoring Plan for Pile Driving. BOEM, BSEE, and/or Atlantic Shores must submit this Plan to NMFS GARFO at least 180 calendar days before impact pile driving for foundations is planned. This plan can be included as a sub-section of the Marine Mammal and Sea Turtle Monitoring Plan addressed above. BOEM, BSEE, and Atlantic Shores must obtain NMFS GARFO's concurrence with this Plan prior to the start of any pile driving. The

Plan must include a description of all proposed PAM equipment and hardware, the calibration data, bandwidth capability and sensitivity of hydrophones, and address how the proposed passive acoustic monitoring will follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.*, 2021). The Plan must describe and include all procedures, documentation, and protocols including information (i.e., testing, reports, equipment specifications) to support that it will be able to detect vocalizing whales within the clearance and shutdown zones, including deployment locations, procedures, detection review methodology, and protocols; hydrophone detection ranges with and without foundation installation activities and data supporting those ranges; communication time between call and detection, and data transmission rates between PAM Operator and PSOs on the pile driving vessel; where PAM Operators will be stationed relative to hydrophones and PSOs on pile driving vessel calling for delay/shutdowns; and a full description of all proposed software, call detectors, and filters. The Plan must also incorporate the requirements relative to North Atlantic right whale reporting in 6.a.

d. Sound Field Verification Plan – WTG, OSS, and Met Tower Foundation Installation. BOEM, BSEE, and/or Atlantic Shores must submit this Plan to NMFS GARFO at least 180 calendar days before pile driving for foundations is planned to begin. BOEM, BSEE, and Atlantic Shores must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of these pile driving activities. To validate the estimated sound field, SFV measurements will be conducted during pile driving of the first three monopiles installed over the course of the Project, with noise attenuation activated. SFV measurements will also be conducted during pile driving of the first full pin pile foundation. The Plan(s) must describe how the first three monopile and first three jacket installation sites and installation scenarios (i.e., hammer energy, number of strikes, total hammer energy) are representative of the rest of the monopile and jacket installations and, therefore, why these monopile and jacket installations would be representative of the remaining monopile and jacket installations. If the monitored pile locations are different from the ones used for exposure modeling, justification must be provided for why these locations are representative of the modeling. In the case that these sites are not determined to be representative of all other monopile and jacket installation sites, Atlantic Shores must include information on how additional foundations would be selected for SFV. The Plan(s) must also include the piling schedule and sequence of events, communication and reporting protocols, methodology for collecting, analyzing, and preparing SFV data for submission to NMFS GARFO including instrument deployment, locations of all hydrophones including direction and distance from the pile, hydrophone sensitivity, recorder/measurement layout, and analysis methods, and a template of the interim report to be submitted. The Plan must also identify the number and location of hydrophones that will be reported in the SFV Interim Reports and any additional hydrophone locations that will be included in the final report(s). The Plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. The Plan must address how Atlantic

Shores will implement Terms and Condition 2a and 2b (see above) which includes, but is not limited to identifying additional noise attenuation measures (e.g., add noise attenuation device, adjust hammer operations, adjust NMS) that will be applied to reduce sound levels if measured distances are greater than those modeled. The plan must describe how Abbreviated SFV Monitoring (consisting of a single acoustic recorder placed at an appropriate distance from the pile) required by Term and Condition 2c will be performed on all foundation installations for which the complete SFV monitoring outlined in 2a and 2b is not carried out. The plan must also outline the anticipated results that will be included in the weekly reports. The plan must also specify steps that will be taken should any exceedances occur.

i. SFV Interim Reports - Pile Driving. BOEM, BSEE, and USACE must require and Atlantic Shores must provide the initial results of the SFV measurements to NMFS GARFO in an interim report. Each report must be submitted to NMFS GARFO as soon as it is available but no later than 48 hours after the installation of each of the first three monopiles each calendar year and no later than 48 hours after the installation of each of the first three full pin pile foundations each calendar year. If technical or other issues prevent submission within 48 hours, Atlantic Shores must notify BOEM, BSEE, and NMFS GARFO within that 48-hour period with the reasons for delay and provide an anticipated schedule for submission of the report. These reports are required for each of the first three monopiles installed each calendar year, each of the first three jacket foundations installed each calendar year, and any additional piles for which complete SFV is required (conditions 2.a and 2.b above). The interim report must include data from hydrophones identified for interim reporting in the SFV Plan and include a summary of pile installation activities (pile diameter, pile weight, pile length, water depth, sediment type, hammer type, total strikes, total installation time [start time, end time], duration of pile driving, max single strike energy, NAS deployments), pile location, recorder locations, modeled and measured distances to thresholds, received levels (rms, peak, and SEL) results from Conductivity, Temperature, and Depth (CTD) casts/sound velocity profiles, signal and kurtosis rise times, pile driving plots, activity logs, weather conditions. Additionally, any important sound attenuation device malfunctions (suspected or definite), must be summarized and substantiated with data (e.g. photos, positions, environmental data, directions, etc.) and observations. Such malfunctions include gaps in the bubble curtain, significant drifting of the bubble curtain, and any other issues which may indicate sub-optimal mitigation performance or are used by Atlantic Shores to explain performance issues. Requirements for actions to be taken based on the results of the SFV are identified in 2.a. above.

ii. The final results of thorough SFV for monopile and pin pile installations must be submitted as soon as possible, but no later than within 90 days following completion of pile driving for which the thorough SFV was carried out.

e. Vessel Strike Avoidance Plan. BOEM, BSEE, and/or Atlantic Shores must submit this plan to NMFS GARFO as soon as possible after issuance of this Biological Opinion but no later than 90 days prior to the planned start of in-water construction activities. The Plan must include an acknowledgement of all relevant mitigation and monitoring measures for listed species inclusive of a summary of all applicable vessel speed restrictions in different operational areas, vessel-based observer protocols for transiting vessels, communication and reporting plans, and a description of proposed alternative monitoring equipment to allow lookouts/PSOs to observe vessel strike avoidance zones in varying weather conditions, sea states, after dark, and in consideration of the use of artificial lighting.

    i. If Atlantic Shores plans to implement PAM in any transit corridor to allow vessel transit above 10 knots, the plan must describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of North Atlantic right whales. PAM information should follow what is required to be submitted for the PAM Plan in 9.c.

10. To implement the requirements of RPM 5, BOEM, BSEE, NMFS OPR, and USACE must exercise their authorities to assess the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA listed species during activities described in this Opinion. These agencies shall immediately exercise their respective authorities to take effective action to ensure prompt implementation and compliance if Atlantic Shores is not complying with: any avoidance, minimization, and monitoring measures incorporated into the proposed action or any term and condition(s) specified in this statement, as currently drafted or otherwise amended in agreement between these agencies and NMFS; if agencies fail to do so, the protective coverage of Section 7(o)(2) may lapse.

11. To implement the requirements of RPM 5, Atlantic Shores must consent to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in the Biological Opinion, for the purposes of evaluating the effectiveness and implementation of measures designed to minimize or monitor incidental take.

12. To implement the requirements of RPM 5, Atlantic Shores, BOEM, BSEE, NMFS OPR, and USACE must immediately notify NMFS GARFO of any identified or suspected non-compliance with any measure outlined in this Incidental Take Statement or in any measure incorporated into the proposed action, including measures included in the Final MMPA authorization. This includes the suspected or identified failure in effectiveness of any such measure. This notification must be submitted as soon as the issue is identified to nmfs.gar.incidental-take@noaa.gov and must include a description of the non-compliance or failure of effectiveness of the measure, the date the issue was identified, and, any corrective actions that were taken. The report of non-compliance must be followed within 48 hours with a request to meet with NMFS GARFO to discuss the report and seek concurrence from NMFS GARFO on the corrective measures.

Table 11.1. Clearance and Shutdown Zones for ESA Listed Species - Impact Pile Driving
These are the PAM detection, minimal visibility, clearance and shutdown zones incorporated into the proposed action; the zones for marine mammals reflect the proposed conditions of the MMPA ITA, and the zones for sea turtles reflect the zone sizes proposed by BOEM. Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility zones. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving; detection of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Impact pile driving for WTG, OSS, and Met Tower foundation installation: 1,900 m minimum visibility zone from each PSO platform (pile driving vessel and at least two PSO vessels), PAM monitoring out to 10,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM	At any distance (Minimum visibility zone (1,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM
Fin, sei, and sperm whale (visual and PAM monitoring)	2,300 m (visual or PAM detection)	1,900 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)

As explained above, reasonable and prudent measures are measures to minimize the amount or extent of incidental take (50 C.F.R. §402.02) that must be implemented in order for the incidental take exemption to be effective. The reasonable and prudent measures and terms and conditions are specified as required by 50 CFR 402.14 (i)(1)(ii), (iii) and (iv) to document the incidental take by the proposed action, minimize the impact of that take on ESA-listed species and, in the case of marine mammals, specify those measures that are necessary to comply with section 101(a)(5) of the Marine Mammal Protection Act of 1972 and applicable regulations with regard to such taking. We document our consideration of these requirements for reasonable and prudent measures and terms and conditions here. We have determined that all of these RPMs and associated terms and conditions are reasonable and necessary or appropriate, to minimize or document take and that they all comply with the minor change rule. That is, none of these RPMs or their implementing terms and conditions alter the basic design, location, scope, duration, or timing of the action, and all involve only minor changes.

RPM 1/Term and Condition 1

The proposed ITA includes a number of general conditions and specific mitigation measures that are considered part of the proposed action. The final ITA issued under the MMPA may have modified or additional measures that clarify or enhance the measures identified in the proposed ITA. Compliance with those measures is necessary and appropriate to minimize and document incidental take of North Atlantic right, sperm, sei, and fin whales. As such, the terms and conditions that require BOEM, BSEE, USACE, and NMFS OPR to ensure compliance with the conditions and mitigation measures of the final ITA are necessary and appropriate to minimize the extent of take of these species and to ensure that take is documented.

RPM 1/Term and Condition 2

The proposed action incorporates requirements for sound field verification (SFV) and outlines general measures to be implemented as a result of SFV. Term and Condition 2 is necessary and appropriate to provide clarification of the required steps related to sound field verification and measures to be implemented as a result of sound field verification. Additionally, this measure requires abbreviated SFV monitoring, using a single hydrophone, during all foundation pile driving where full SFV monitoring is not carried out. This requirement implements one of the recommendations included in BOEM's August 2023 *Recommendations for Offshore Wind Project Pile Driving Sound Exposure Modeling and Sound Field Measurement*[61]. This measure is necessary and appropriate to monitor take; the exposure estimates and amount and extent of incidental take exempted in this ITS are based on the size of the area that will experience noise above the identified thresholds during pile driving. While the initial, full SFV monitoring, and the associated steps to require any changes to the noise attenuation system, are designed to ensure that pile driving will proceed in a way that is not expected to exceed the modeled distances, there is likely to be variability in pile driving and there may be issues with the sound attenuation systems (e.g., poor bubble curtain performance) that would be undetected without at least minimal SFV monitoring. We expect that the required abbreviated SFV will both allow a continuous check on noise levels and the attenuation system which will allow us to monitor take in a way that supplements detections of sea turtles and whales by the PSOs, but also allow for expeditious detection of any issues with the noise attenuation system or unanticipated variations in noise produced during pile driving so that adjustments can be made and Atlantic Shores can avoid exceeding the amount and extent of take exempted herein. Additionally, we have determined in this Opinion that take of Atlantic sturgeon as a result of exposure to pile driving

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[61] https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEMOffshoreWindPileDrivingSoundModelingGuidance.pdf; last accessed December 1, 2023.

noise is not expected and no take has been exempted; because PSOs cannot see sturgeon, this abbreviated SFV monitoring will allow for monitoring of noise levels to compare to the modeled distances to the injury and behavioral disturbance thresholds for sturgeon and ensure that these distances are not exceeded.

RPM 2 /Term and Condition 3

As explained above, take that may occur of Atlantic and shortnose sturgeon as a result of vessel strike is expected to occur from Atlantic Shores' vessels transiting in the Delaware River/Bay as they move to/from the New Jersey Wind Port and Paulsboro Marine Terminal. In this Opinion, we have identified the portion of the take identified in the New Jersey Wind Port and Paulsboro Biological Opinions that will be attributable to Atlantic Shores' vessels. That take is exempted through the Incidental Take Statement issued with NMFS' Biological Opinions for those projects. Here, we identify the relevant RPMs and Terms and Conditions from those ITSs that must be complied with in order for the relevant take exemption included in the New Jersey Wind Port and Paulsboro Opinion to apply.

RPM 3/Term and Conditions 4, 5, and 8

Documenting take that occurs is essential to ensure that reinitiation of consultation occurs if the amount or extent of take identified in the ITS is exceeded. Some measures for documenting and reporting take are included in the proposed action. The requirements of Term and Conditions 5, 6, and 9 enhance or clarify those requirements. Documentation and timely reporting of observations of whales, sea turtles, and Atlantic sturgeon is important to monitoring the amount or extent of actual take compared to the amount or extent of take exempted. The reporting requirements included here will allow us to track the progress of the action and associated take. Proper identification and handling of any sturgeon and sea turtles that are captured in the survey gear is essential for documenting take and to minimize the extent of that take (i.e., reducing the potential for further stress, injury, or mortality). The measures identified here are consistent with established best practices for proper handling and documentation of these species. Identifying existing tags helps to monitor take by identifying individual animals. Requiring genetic samples (fin clips) from all Atlantic sturgeon and that those samples be analyzed to determine the DPS of origin is essential for monitoring actual take as genetic analysis is the only way to identify the DPS of origin for subadult and adult Atlantic sturgeon captured in the ocean. Taking fin clips is not expected to increase stress or result in any injury of Atlantic sturgeon; effects of taking the fin clips are consistent with the effects of the fisheries surveys addressed in this Opinion (i.e., harassment and minor, recoverable injury). The requirements for observer qualifications in Term and Condition 9 are necessary and appropriate to ensure that handling and documentation of sturgeon and turtles collected in the trawl survey is done by appropriately trained personnel, which will minimize the extent of take by reducing the risk of unintentional stress or injury that could result from inappropriate or extended handling of captured individuals.

RPM 3/Term and Condition 6

We recognize that documenting sea turtles that were struck by project vessels may be difficult given their small size and the factors that contribute to cryptic mortality addressed in the *Effects of the Action* section of this Opinion. Therefore, we are requiring that BOEM, BSEE, and Atlantic Shores document any and all observations of dead or injured sea turtles over the course of the project and that we meet twice annually to review that data and determine which, if any, of those sea turtles have a cause of death that is attributable to project operations. We expect that we will consider the factors reported with the particular turtle (i.e., did the lookout suspect the vessel struck the turtle), the state of decomposition, any observable injuries, and the extent to which project vessel traffic contributed to overall traffic in the area at the time of detection.

RPM 3/Term and Condition 7

Term and Condition 8 requires BOEM, BSEE, and/or USACE to provide updates on certain project information (listed in the condition) to us following BSEE's review of the Facility Design Report (FDR) and/or Fabrication and Installation Report or whenever the identified information is available. Because Atlantic Shores used a project design envelope for environmental permitting, a number of the project parameters have not been finalized. Receipt of this information from BOEM, BSEE, or USACE is necessary for us to ensure that the project to be constructed is consistent with the description of the proposed action in the Opinion and allows us an opportunity to identify if any changes to the ITS would be appropriate. For example, if the project described in the FDR includes significantly fewer WTG foundations than described in the Opinion, adjustments to the amount of exempted take may be appropriate. Requiring the submission of information on how the project will be implemented is necessary and appropriate to allow us to determine if the amount or extent of take is likely to be exceeded (or alternatively, if it would be an overestimate), and allows for us to accurately monitor the proposed action and associated incidental take.

RPM 4/Term and Condition 9

A number of plans are proposed for development and submission by Atlantic Shores and/or required for submission by BOEM, BSEE, or NMFS OPR. Term and Condition 9 identifies all of the plans that must be submitted to NMFS GARFO, identifies timeline for submission, and clarifies any relevant requirements. This will minimize confusion over submission of plans and facilitate efficient review of the plans. Implementation of these plans will minimize or monitor take, dependent on the plan. Obtaining NMFS concurrence with these plans prior to implementation of the associated activity is necessary and appropriate to ensure that the activities are carried out in a way that is consistent with the proposed action described herein, including compliance with the avoidance, minimization, or monitoring measures built into the proposed action, or to ensure that the measures outlined in this ITS are implemented as intended. Preparation, review, and concurrence with these plans is necessary because the relevant details were not available at the time this consultation was initiated or completed.

RPM 5/Term and Condition 10-12

RPM 6 and its associated terms and conditions are reasonable and necessary or appropriate to minimize and monitor incidental take. Measures to minimize and monitor incidental take, whether part of the proposed action or this ITS, first must be implemented in order to achieve the beneficial results anticipated in this Opinion for ESA listed species. The action agencies exercising their authorities to assess and ensure compliance with the measures to avoid, minimize, monitor, and report incidental take of ESA listed species, including the measures that were incorporated into the description of the proposed action is an essential component of ensuring that incidental take is minimized and monitored. Likewise, such measures once implemented must be effective at minimizing and monitoring incidental take consistent with the analysis. While the measures described as part of the proposed action and in the ITS are consistent with best practices in other industries, and are anticipated to be practicable and functional, gathering information in situ through observation, inspection, and assessment may confirm expectations or reveal room for improvement in a measure's design or performance, or in Atlantic Shores' implementation and compliance. While the ITS states that action agencies must adopt the RPMs and terms and conditions as enforceable conditions in their own actions, and while each agency is responsible for oversight regarding its own actions taken, specifying that Atlantic Shores must consent to NOAA (or other enforcement related) personnel's attendance during offshore wind activities clarifies its role as well. Given the nascence of the U.S. offshore wind industry information gathering on the implementation and effectiveness of these measures will help ensure that effects to listed species and their habitat are minimized and monitored. Term and Condition 13 requires prompt notification of any non-compliance with measures that are designed to avoid, minimize, or monitor effects to ESA listed species; this is necessary not only to monitor incidental take and the implementation of this ITS but also to ensure that appropriate corrective actions are taken. This will also facilitate identification of any need to reinitiate this consultation.

12.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information in furtherance of these identified purposes. As such, NMFS recommends that the BOEM, BSEE, USACE, and the other action agencies implement the following Conservation Recommendations consistent with their authorities:

1. Work with the lessee to develop a construction schedule that further reduces potential exposure of North Atlantic right whales to noise from pile driving including avoiding impact pile driving in May and December.
2. Collect data to add to the limited information we have on underwater noise generated during vibratory pile driving for installation and removal of sheet piles and on operational noise of the direct drive wind turbines in the action area.
    - i. If sheet pile cofferdams are used at the sea-to-shore transition, sound field verification should be carried out during installation and removal of at least one cofferdam.
    - ii. A study to document operational noise of WTGs during a variety of wind and weather conditions should be carried out.
3. Support research and development of technology to aid in the minimization of risk of vessel strikes on marine mammals, sea turtles, and Atlantic sturgeon.
4. Support development of regional monitoring of project and cumulative effects through the Regional Wildlife Science Collaborative for Offshore Wind (RWSC).
5. Work with the NEFSC to support robust monitoring and study design with adequate sample sizes, appropriate spatial and temporal coverage, and proper design allowing the

detection of potential impacts of offshore wind projects on a wide range of ecological and oceanographic conditions including protected species distribution, prey distribution, pelagic habitat, and habitat usage.

6. Support research into understanding the effects of offshore wind on regional oceanic and atmospheric conditions through modeling and data collection, and assessment of potential impacts on protected species, their habitats, and distribution of zooplankton and other prey.
7. Support the continuation of aerial surveys for post-construction monitoring of listed species in the Atlantic Shores WFA and surrounding waters, and methods for survey adaptation to the presence of wind turbines.
8. Support research on construction and operational impacts to protected species distribution, particularly the North Atlantic right whale and other listed whales. Conduct monitoring pre/during/post construction, including long-term monitoring during the operational phase, including sound sources associated with turbine maintenance (e.g., service vessels), to understand any changes in protected species distribution and habitat use in southern New England.
9. Support the deployment of acoustic tags on sea turtles and sturgeon and the continued maintenance of the receiver array in the Atlantic Shores WDA.
10. Support research regarding the abundance and distribution of Atlantic sturgeon in the Atlantic Shores WDA and surrounding region in order to understand the distribution and habitat use and aid in density modeling efforts, including the continued use of acoustic telemetry networks to monitor for tagged fish.
11. Require the lessee to send all acoustic telemetry metadata and detections to the Mid-Atlantic Acoustic Telemetry Observation System (MATOS) database via https://matos.asascience.com/ for coordinated tracking of marine species over broader spatial scales in US Animal Tracking Network and Ocean Tracking Network.
12. Conduct or support long-term ecological monitoring to document the changes to the ecological communities on, around, and between foundations and other benthic areas disturbed by the proposed Project.
13. Develop or support the development of a PAM array in the Atlantic Shores WDA to monitor changes in ambient noise and use of the area by baleen whales (and other marine mammals) during the life of the Project, including construction, and to detect small-scale changes at the scale of the Atlantic Shores Wind WDA. Bottom mounted recorders should be deployed at a maximum of 20 km distance from each other throughout the given study area in order to ensure near to complete coverage of the area over which North Atlantic right whales and other baleen whales can be heard. See Van Parijs et al. 2021 for specific details. Resulting data products should be provided according to https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates.
14. Support the development of a regional PAM network across lease areas to monitor long-term changes in baleen whale distribution and habitat use. A regional PAM network should consider adequate array/hydrophone design, equipment, and data evaluation to

understand changes over the spatial scales that are relevant to these species for the duration of these projects, as well as the storage and dissemination of these data.

15. Monitor changes in commercial fishing activity to detect changes in bycatch or entanglement rates of protected species, particularly the North Atlantic right whale, and support the adaptation of ropeless fishing practices where necessary. Conduct regular surveys and removal of marine debris from project infrastructure.
16. Provide support to groups that participate in regional stranding networks.

13.0 REINITIATION NOTICE

This concludes formal consultation for the proposed authorizations associated listed herein for the Atlantic Shores South offshore energy project. As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required and shall be requested by the Federal action agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) If the amount or extent of taking specified in the incidental take statement is exceeded;

(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or,

(4) If a new species is listed or critical habitat designated that may be affected by the identified action.

14.0 LITERATURE CITED

Note: citations are organized by section of the Biological Opinion in the heading below; citations that appear in more than one section may appear more than once in this list.

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7.8 Unexpected/Unanticipated Events

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9.0 Integration and Synthesis of Effects

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12.0 Conservation Recommendations

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APPENDIX A

Proposed Mitigation, Monitoring, and Reporting Measures in Committed to by the Applicant in their MMPA LOA Application, Included in the Proposed Action for Consultation with NMFS under the ESA (Table 1-10 in BOEM's BA)

PSO and 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. • 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 operator resumes will be provided to NMFS for review and approval prior to the start of activities. • PSOs and PAM operators will complete a Permits and Environmental Compliance Plan 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). • Situational awareness/common operating picture and coordination: Atlantic Shores will establish a situational awareness network for marine mammal 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 the U.S. Coast Guard VHF Channel 16 throughout the day to receive notifications of any sighting; and	C

Measure		
	monitor any existing real-time acoustic networks.	
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; • Observations will be conducted from the best available vantage point(s) on the vessels (stable, elevated platform from which PSOs have an unobstructed 360-degree 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 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.	C
Acoustic monitoring (WTG and OSS foundation installation only)	• Deployment of PAM system will be outside the perimeter of the shutdown zone (SZ); and • PAM operators will be given adequate breaks and will work no longer than 12 hours per day.	C
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. 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. 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 NMFS 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	C, O&M

	comply with the necessary requirements throughout activities offshore; • Vessel personnel will maintain a vigilant watch for marine mammals and slow down or maneuver vessel 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). <u>Operational Separation Distances</u> • Vessels will maintain, to the extent practicable, separation distances of: – Greater than 546 yard (500 meter) distance from any sighted NARW or unidentified large marine mammals – Greater than 109 yards (100 meters) from all other whales; and – Greater than 54 yards (50 meters) from dolphins, porpoises, and seals. <u>Standard Vessel Avoidance Plan</u> • Implement Base Conditions as described above; • **Between November 1st and April 30th:** Vessels greater than or equal to 65 feet (19.8 meters) 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 feet (19.8 meters) 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 greater than 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-degree direction of the forward path of the vessel (90 degrees port to 90 degrees 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. <u>Adaptive Vessel Avoidance Plan</u> 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	

Measure		Project Phase
	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 feet (19.8 meters) 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 (i.e., the path a Project vessel will use to transit between the Project Area and the port from which the vessel is operating) 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 slow-down zone 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 at greater than 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-degree direction of the forward path of the vessel (90 degrees port to 90 degrees 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 (i.e., an action zone in which a NARW detection has been made within the last 12 hours) within the DMA may trigger a slow down as described above; and • If PAM and/or thermal systems are offline, the Standard	

Measure		Project Phase
	Vessel Avoidance Plan measures will apply for the respective zone (where PAM is offline) or vessel (if automated visual systems are offline).	
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.	C, O&M
Reporting	Atlantic Shores will immediately report to appropriate POCs in the following situations: • If a stranded, entangled, injured, or dead marine mammal 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 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.	C, O&M
Visual monitoring for WTG and OSS foundation installation	• 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 • At least two visual PSOs will be on watch on each construction and secondary vessel during pre-start clearance, throughout	C

Measure		Project Phase
	impact pile driving, and 30 minutes after piling is completed. 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 reticule 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. 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 calling in the area. 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; 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.	
Acoustic monitoring for WTG and OSS foundation installation	• 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.	C
Shutdown zones for WTG and OSS foundation installation	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 in the table below. The mitigation zones are subject to modification based on final engineering design. These zones and ranges are based on modeled piling scenarios for monopile and jacket pile installation and assume 10 dB	C

<table>
<tr><th>Measure</th><th>Description</th><th>Project Phase</th></tr>
<tr><td></td><td>broadband noise attenuation. Mitigation zones established for all species, including NARW, will be applied accordingly as depicted in the table below. Monitoring zones 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 modeled injury threshold distances differed among these scenarios, the largest for each species group was selected for conservatism. The pre-piling clearance 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 of each group.
<table>
<tr><th>Species Group</th><th>Clearance Zone (m)</th><th>Shutdown Zone (m)</th><th>Level B Monitoring Zone (m)</th></tr>
<tr><td>NARW</td><td>1,900</td><td>1,900</td><td>3,900</td></tr>
<tr><td>Large whales</td><td>1,900</td><td>1,900</td><td>3,900</td></tr>
<tr><td>Delphinids</td><td>1,900</td><td>N/A</td><td>3,900</td></tr>
<tr><td>Harbor porpoise</td><td>1,900</td><td>1,480</td><td>3,900</td></tr>
<tr><td>Seals</td><td>1,900</td><td>320</td><td>3,900</td></tr>
</table></td><td></td></tr>
<tr><td>Pre-start clearance for WTG and OSS foundation installation</td><td>• 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 the 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).</td><td>C</td></tr>
<tr><td>Ramp up (Soft start) for WTG and OSS foundation installation</td><td>• 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 have 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</td><td>C</td></tr>
</table>

Measure	Description	Project Phase
	additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).	
Shutdowns for WTG and OSS foundation installation	• 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.	C
Post-piling monitoring for WTG and OSS foundation installation	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.	C
Noise attenuation for WTG and OSS foundation installation	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.	C
Sound measurements for WTG and OSS foundation installation	• Measurements of the installation of at least one WTG and one OSS foundation. If different piled foundation types are selected for the WTGs and/or OSSs between Projects 1 and 2, sound field verification will be conducted for at least one foundation of each piled type. Results of sound field verification will be 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 Monitoring Zone	C
Visual monitoring for HRG surveys with sound sources with operating frequencies below 180 kHz	• 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. Daytime Visual Monitoring (period between nautical twilight rise and set for the region) • One PSO on watch during all pre-clearance periods and source operation; and	C, O&M

Measure	Description	Project Phase
	• PSOs will use reticule binoculars and the naked eye to scan the monitoring zone for marine mammals. 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.	
Shutdown zones for HRG surveys with sound sources with operating frequencies below 180 kHz	• NARW: 547 yards (500 meters) • All other marine mammal species: 109 yards (100 meters) • Certain Delphinus, Lagenorhynchus, Stenella, or Tursiops that are visually detected as voluntarily approaching the vessel or towed equipment: No SZ	C. O&M
Pre-start clearance for HRG surveys with sound sources with operating frequencies below 180 kHz	Pre-start clearance will be conducted during HRG surveys using impulsive sources or non-parametric sub-bottom profilers. • Prior to 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 less than 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).	C, O&M
Ramp-up (Soft start) for HRG surveys with sound sources with operating frequencies below 180 kHz	Ramp-up will be conducted during HRG surveys using impulsive sources or non-parametric sub-bottom profilers. • 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).	C, O&M
Shutdowns for HRG surveys with sound sources with operating frequencies below 180 kHz	• Shutdown of impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies below 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;	C, O&M

Measure	Description	Project Phase
	• 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.	
Visual monitoring for cofferdam installation and removal	• 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. <u>Daytime Visual Monitoring</u> • Two PSOs will maintain watch during the pre-start clearance period, throughout the 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. <u>Daytime Visual Monitoring during Periods of Low Visibility</u> • One PSO will monitor the SZ with the mounted IR camera while the other maintains visual watch with the naked eye/binoculars.	C
Shutdown zones for cofferdam installation and removal	The following shutdown zones will be enacted during vibratory piling if safe and technically feasible to do so: • Large whales (baleen whales and sperm whales): 328 feet (100 meters); • Mid-frequency cetaceans other than sperm whale: 164 feet (50 meters); • Harbor porpoise (high-frequency cetacean): 492 feet (150 meters) • Seals: 197 feet (60 meters)	C
Pre-start clearance for cofferdam installation and removal	• 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).	C
Ramp-up (Soft start) for cofferdam installation and removal	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.	C
Shutdowns for cofferdam installation and removal	• If a marine mammal is observed entering or within the respective SZs after sheet pile installation has commenced, a	C

Measure	Description	Project Phase
	shutdown will be implemented; and • 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).	

C = construction period; O&M = operation and maintenance period; D = decommissioning period

BOEM-proposed Mitigation, Monitoring, and Reporting Measures Included in the Proposed Action (Table 1-11 in BOEM's BA)

	Description	Project Phase
Incorporate LOA requirements	The measures required by the final MMPA LOA would be incorporated by reference where appropriate into COP approval, and BOEM and/or BSEE would monitor compliance with these measures.	Project Years 1 – 5 (C, O&M)
Marine debris awareness training	The Lessee would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Recordkeeping and the availability of records for inspection by DOI. By January 31 of each year, the Lessee would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. The Lessee would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	Pre-C, C, O&M, D
Passive Acoustic Monitoring	BOEM and USACE would ensure that Atlantic Shores	C, O&M

Measure	Description	Project Phase
(PAM) Plan	prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan would be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	
Pile Driving Monitoring Plan	BOEM would ensure that Atlantic Shores prepares and submits a *Pile Driving Monitoring Plan* to NMFS for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM and Atlantic Shores would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Atlantic Shores would obtain NMFS' concurrence with this plan prior to starting any pile driving.	C
PSO coverage	BOEM and USACE would ensure that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile driving delays or shutdown requirements during foundation installation. This will include a PSO/PAM team on the construction vessel and two additional PSO vessels each with a visual monitoring team. The following equipment and personnel will be on each associated vessel. ***Construction Vessel:*** • 2—visual PSOs on watch. • 2—reticle binoculars (7x or 10x) calibrated for observer height off the water. • 2—mounted "big eye" binoculars (25x or similar) if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1—PAM operator on duty. • 1—mounted thermal/infrared camera system. • 2— "big eye" binoculars (25x or similar) mounted 180° apart. • 1—monitoring station for real-time PAM system. • 2—handheld or wearable night vision devices with infrared spotlights. • 1—data collection software system. • 2—PSO-dedicated VHF radios. • 1—digital single-lens reflex camera equipped with a 300-millimeter lens. ***Each Additional PSO Vessel (2):*** • 2—visual PSOs on watch. • 2—reticle binoculars (7x or 10x) calibrated for observer height off the water.	C

Measure	Description	Project Phase
	• 1—mounted "big eye" binoculars (25x or similar) if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective.1—mounted thermal/IR camera system. • 1—handheld or wearable night vision device with infrared • spotlight. • 1—data collection software system. • 2—PSO-dedicated VHF radios. • 1—digital single lens reflex camera equipped with a 300-mm lens. If, at any point prior to or during construction, the PSO coverage that is included as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs and/or platforms would be deployed. Determinations prior to construction would be based on review of the *Pile Driving Monitoring Plan*. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	
Sound field verification	Applicant proposed measures plus: BOEM and USACE would ensure that if the clearance and/or shutdown zones are expanded due to the verification of sound fields from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance and/or shutdown zones. Additional observers would be deployed on additional platforms for every 1,500 meters that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	C
Adaptive shutdown zones	BOEM and USACE may consider reductions in the shutdown zones for ESA-listed sei, fin, or sperm whales based upon sound field verification of a minimum of 3 piles. Sound field verification of additional piles may be required based on results of actual measurements. However, BOEM/USACE would ensure that the shutdown zone for sei, fin, and sperm whales is not reduced to less than 1,000 m, or 500 m for ESA-listed sea turtles. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of sound field verification of a minimum of three piles.	C
Monitoring zone for sea turtles	BOEM and USACE would ensure that Atlantic Shores monitors the full extent of the area where noise would exceed the 175 dB rms threshold for ESA-listed sea turtles for the full duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and record all observations in order to ensure that all take that occurs is documented.	C
Look out for sea turtles and reporting	a. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, Atlantic Shores would have a trained lookout posted on all	Pre-C, C, O&M, D

Measure	Description	Project Phase
	vessel transits during all phases of the Projects to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented. b. For all vessels operating south of the Virginia/North Carolina border, year-round, Atlantic Shores would have a trained lookout posted on all vessel transits during all phases of the Projects to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented. This requirement would be in place year-round for any vessels transiting south of Virginia, as sea turtles are present year-round in those waters. c. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. d. The trained lookout would maintain a vigilant watch and monitor a 500-m Vessel Strike Avoidance Zone at all times to minimize potential vessel strikes of ESA-listed sea turtle species. Alternative monitoring technology (e.g., night vision, thermal cameras, etc.) would be available to ensure effective watch at night and in any other low visibility conditions. If the trained lookout is a vessel crew member, this would be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts would receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. e. If a sea turtle is sighted within 100 m or less of the operating vessel’s forward path, the vessel operator would slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m at which time the vessel may resume normal operations. If a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. f. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas. g. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all Project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and	

Measure	Description	Project Phase
	posted in highly visible locations aboard all Project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. h. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they must be reported to NMFS within 24 hours. i. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout is not required and this PSO or trained lookout must maintain watch for whales and sea turtles. j. Vessel transits to and from the Wind Farm Area, that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 100 m avoidance measure.	
Vessel strike avoidance for marine mammals	Atlantic Shores must continue to implement vessel strike avoidance measures to include the identified vessel speed restrictions and minimum separation distances for crew transfer vessels agreed to in the Applicant-proposed measures (Table G-1, Measure # LOA-4).	C, O&M
Vessel strike avoidance for Rice's whale	When transiting the Gulf of Mexico, Project vessels will comply with the vessel strike avoidance measures detailed in Measure No. 4 in **Table 1-10**, as well as additional measures specific to Rice's whale, including but not limited to the following: • Vessels will maintain, to the greatest extent practicable, a separation distance of greater than 546 yards (500 meters) from any sighted Rice's whale or unidentified large marine mammals; and • All underway vessels operating at greater than 10 knots will have a dedicated visual observer (may be third-party observer or crew member) on duty at all times to monitor for marine mammals within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog, etc.) and 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. NMFS may require different or additional measures as part of the Reasonable and Prudent Measures or Terms and Conditions in the Project's Biological Opinion which would supplement or supersede the measures outlined above.	C
Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	All fisheries surveys

Measure	Description	Project Phase
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using yellow and black striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are therefore distinct. Any changes in marking would not be made without notification and approval from NMFS.	Pot/trap surveys
Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	All fisheries surveys
Survey training	At least one of the survey staff onboard the trawl surveys and ventless trap surveys would have completed NEFOP observer training (within the last 5 years) or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures would be available on board each survey vessel. BOEM would ensure that Atlantic Shores prepares a training plan that addresses how this requirement would be met and that the plan is submitted to NMFS in advance of any trawl or trap surveys. This requirement is in place for any trips where gear is set or hauled.	Trawl and ventless trap surveys
Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	Pot/trap surveys
Sea turtle/Atlantic sturgeon identification and data collection	Any sea turtles or Atlantic sturgeon caught and/or retrieved in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught and/or retrieved would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. a. The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed (https://media.fisheries.noaa.gov/2021-	All fisheries surveys

Measure	Description	Project Phase
	11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). b. Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below). c. Genetic samples would be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dam-migration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips would be sent to a NMFS-approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of the Project BiOp with ITS. Results of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?nullhttps://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. d. All captured sea turtles and Atlantic sturgeon would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described in the take notification measure below.	
Sea turtle/Atlantic sturgeon handling and resuscitation guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for	All fisheries surveys

Measure	Description	Project Phase
	those handling and resuscitating the animal(s) to do so. Specifically: a. Priority would be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. b. All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the Proposed Action. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. d. Attempts would be made to resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). e. Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or Atlantic sturgeon would be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore as safe to do so. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.	
Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles, and Atlantic sturgeon occurring as a result of any fisheries survey. Specifically: a. GARFO PRD would be notified within 24 hours of any	All fisheries surveys

Measure	Description	Project Phase
	interaction with a sea turtle or sturgeon (nmfs.gar.incidental-take@noaa.gov). The report would include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the e-mail would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. b. At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.	
Monthly/annual reporting requirements	BOEM would ensure that Atlantic Shores implements the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the Proposed Action: a. All reports would be sent to: nmfs.gar.incidental-take@noaa.gov. b. During the construction phase and for the first year of operations, Atlantic Shores would compile and submit monthly reports that include a summary of all Project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. c. Beginning in year 2 of operations, Atlantic Shores would compile and submit annual reports that include a summary of all Project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	C, O&M
BOEM/NMFS meeting	To facilitate monitoring of the incidental take exemption for	C, O&M Year 1

Measure	Description	Project Phase
requirements for sea turtle take documentation	sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would be held in September (to review observations through August of that year) and December (to review observations from September to November) and would use the best available information on sea turtle presence, distribution, and abundance, Project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to Project operations. These meetings would continue on an annual basis following year 1 of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	
Data Collection BA BMPs	BOEM would ensure that all Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Atlantic Shores Wind project as applicable.	Pre-C, C, O&M, D
Alternative Monitoring Plan (AMP) for pile driving	The Lessee must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. The Lessee must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring technologies such as night vision, thermal, and infrared technologies, and use of PAM and must demonstrate the ability and effectiveness to maintain clearance all pre-clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined below in Part 2 to BOEM's and NMFS's satisfaction. The AMP must include two stand-alone components as described below: • Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as one hour after civil sunrise to 1.5 hours before civil sunset. • Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to one hour after civil sunrise. If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, the Lessee would follow the shutdown procedures outlined in Section 1.4.4 of the Protected Species Management and Equipment Specifications Plan. The Lessee would notify BOEM and NMFS of any shutdown occurrence during pile driving operations within 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS.	C

Measure	Description	Project Phase
	The AMP should include, but is not limited to the following information: • Identification of night vision devices (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights), if proposed for use to detect protected marine mammal and sea turtle species. • The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. • Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available). • Procedures and timeframes for notifying NMFS and BOEM of Atlantic Shores' intent to pursue nighttime pile driving. • Reporting procedures, contacts and timeframes. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP	
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	The Lessee must monitor indirect impacts associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least ten of the WTGs located closest to shore in each Project 1 and Project 2 area of the ASOW-S Lease Area (OCS-A 0499) annually. If Atlantic Shores utilizes piled jacket foundations for WTGs in Project 2, BOEM may increase the number of foundations that must be surveyed in Project 2. Survey design and effort (i.e., the number of WTGs and frequency of reporting) may be modified only upon concurrence by BOEM and BSEE.. The Lessee must conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris. The Lessee must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30 for the preceding calendar year. Annual reports must be submitted in Microsoft Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic and/or video	O&M

Measure	Description	Project Phase
	documentation of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place). Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	
PDC minimize vessel interactions with listed species (from HRG Programmatic)	All vessels associated with survey activities (transiting [i.e., travelling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. • If any ESA-listed marine mammal is sighted within 500 m of the forward path of a vessel, the vessel operator must steer a course away from the whale at <10 knots (18.5 km/hr) until the minimum separation distance has been established. Vessels may also shift to idle if feasible. • If any ESA-listed marine mammal is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 meters. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m.	Pre-C, C, O&M, D
Operational Sound Field Verification Plan	BOEM would require the Lessee to develop an operational sound field verification plan to determine the operational noises emitted from the Offshore Wind Area. The plan would be reviewed and approved by BOEM and NMFS. The plan would be reviewed and approved by BOEM and NMFS. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving).	O&M
Long-term PAM	Atlantic Shores must conduct long-term PAM to record ambient noise and marine mammal calls in the Lease Area. Alternately, Atlantic Shores may make a financial contribution to BOEM's Environmental Studies Partnership for an Offshore Wind Energy Regional Observation Network to support PAM monitoring on non-lease areas.	C, O&M, D
Sound field verification of foundation installation	Atlantic Shores must submit a Sound Field Verification Plan consistent with requirements of the NMFS Biological Opinion. The results of sound field verification must be compared to modeled injury and disturbance isopleths for marine mammals.	C
Minimum visibility requirement	In order to commence pile driving at foundations, PSOs must be able to visually monitor a 6,244-foot (1,900- meter) radius from their observation points for at least 60 minutes immediately prior to piling commencement. In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) radius from their observation points for at least 30 minutes immediately prior to piling	C

Measure	Description	Project Phase
	commencement. Acceptable visibility will be determined by the Lead PSO.	

C = construction period; O&M = operation and maintenance period; D = decommissioning period

APPENDIX B

MITIGATION MEASURES INCLUDED IN MMPA PROPOSED RULE – ATLANTIC SHORES (88 FR 654300)

When conducting the activities identified in §§ 217.300(c) within the specified geographical area described in § 217.300(b), LOA Holder must implement the mitigation measures contained in this section and any LOAs issued under §§ 217.306 and 217.307. These mitigation measures include, but are not limited to:

(a) *General conditions.* LOA Holder must comply with the following general measures:

(1) A copy of any issued LOAs must be in the possession of LOA Holder and its designees, all vessel operators, visual protected species observers (PSOs), passive acoustic monitoring (PAM) operators, pile driver operators, and any other relevant designees operating under the authority of the issued LOAs;

(2) LOA Holder must conduct training for construction, survey, and vessel personnel and the marine mammal monitoring team (PSO and PAM operators) prior to the start of all in-water construction activities in order to explain responsibilities, communication procedures, marine mammal detection and identification, mitigation, monitoring, and reporting requirements, safety and operational procedures, and authorities of the marine mammal monitoring team(s). This training must be repeated for new personnel who join the work during the project. A description of the training program must be provided to NMFS at least 60 days prior to the initial training before in-water activities begin. Confirmation of all required training must be documented on a training course log sheet and reported to NMFS Office of Protected Resources prior to initiating project activities;

(3) Prior to and when conducting any in-water activities and vessel operations, LOA Holder personnel and contractors (*e.g.,* vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the Project Area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of U.S. Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (*i.e.*, Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators, PSO(s), and PAM operator(s); The marine mammal monitoring team must monitor these systems no less than every 4 hours.

(4) Any marine mammal observed by project personnel must be immediately communicated to any on-duty PSOs, PAM operator(s), and all vessel captains. Any large whale observation or acoustic detection by PSOs or PAM operators must be conveyed to all vessel captains;

(5) For North Atlantic right whales, any visual or acoustic detection must trigger a delay to the commencement of pile driving and HRG surveys.

(6) In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale, it must be treated as if it were a North Atlantic right whale for purposes of mitigation;

(7) If a delay to commencing an activity is called for by the Lead PSO or PAM operator, LOA Holder must take the required mitigative action. If a shutdown of an activity is called for by the Lead PSO or PAM operator, LOA Holder must take the required mitigative action unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or

pile instability. Any disagreements between the Lead PSO, PAM operator, and the activity operator regarding delays or shutdowns would only be discussed after the mitigative action has occurred;

(8) If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone prior to beginning a specified activity, the activity must be delayed. If the activity is ongoing, it must be shut down immediately, unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. The activity must not commence or resume until the animal(s) has been confirmed to have left and is on a path away from the Level B harassment zone or after 15 minutes for odontocetes (excluding sperm whales) and pinnipeds, and 30 minutes for all other species with no further sightings;

(9) For in-water construction heavy machinery activities listed in § 217.300(c), if a marine mammal is on a path towards or comes within 10 meters (m) (32.8 feet) of equipment, LOA Holder must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment;

(10) All vessels must be equipped with a properly installed, operational Automatic Identification System (AIS) device and LOA Holder must report all Maritime Mobile Service Identify (MMSI) numbers to NMFS Office of Protected Resources;

(11) By accepting the issued LOAs, LOA Holder consents to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in this subpart, for the purposes of evaluating the implementation and effectiveness of measures contained within the LOAs and this subpart; and

(12) It is prohibited to assault, harm, harass (including sexually harass), oppose, impede, intimidate, impair, or in any way influence or interfere with a PSO, PAM Operator, or vessel crew member acting as an observer, or attempt the same. This prohibition includes, but is not limited to, any action that interferes with an observer's responsibilities, or that creates an intimidating, hostile, or offensive environment. Personnel may report any violations to the NMFS Office of Law Enforcement.

(b) *Vessel strike avoidance measures.* LOA Holder must comply with the following vessel strike avoidance measures, unless an emergency situation presents a threat to the health, safety, or life of a person or when a vessel, actively engaged in emergency rescue or response duties, including vessel-in-distress or environmental crisis response, requires speeds in excess of 10 kn to fulfill those responsibilities, while in the specified geographical region:

(1) Prior to the start of the Project’s activities involving vessels, LOA Holder must receive a protected species training that covers, at a minimum, identification of marine mammals that have the potential to occur where vessels would be operating; detection observation methods in both good weather conditions (*i.e.*, clear visibility, low winds, low sea states) and bad weather conditions (*i.e.*, fog, high winds, high sea states, with glare); sighting communication protocols; all vessel speed and approach limit mitigation requirements (*e.g.*, vessel strike avoidance measures); and information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species. This training must be repeated for any new vessel personnel who join the Project. Confirmation of the observers’ training and understanding of the Incidental Take Authorization (ITA) requirements must be documented on a training course log sheet and reported to NMFS;

(2) LOA Holder, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course to avoid striking any marine mammal;

(3) LOA Holder's underway vessels (*e.g.*, transiting, surveying) operating at any speed must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard) located at an appropriate vantage point for ensuring vessels are maintaining appropriate separation distances. Visual observers must be equipped with alternative monitoring technology (*e.g.*, night vision devices, infrared cameras) for periods of low visibility (*e.g.*, darkness, rain, fog, *etc*.). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this subpart. Visual observers may be third-party observers (*i.e.*, NMFS-approved PSOs) or trained crew members, as defined in § 217.305 (a)(1).

(4) LOA Holder must continuously monitor the U.S. Coast Guard VHF Channel 16 at the onset of transiting through the duration of transiting, over which North Atlantic right whale sightings are broadcasted. At the onset of transiting and at least once every 4 hours, vessel operators and/or trained crew member(s) must also monitor the LOA Holder's Project-wide Situational Awareness System, WhaleAlert, and relevant NOAA information systems such as the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales;

(5) All LOA Holder's vessels must transit at 10 kn or less within any active North Atlantic right whale Slow Zone (*i.e.*, Dynamic Management Areas (DMAs) or acoustically-triggered slow zone);

(6) LOA Holder's vessels, regardless of size, must immediately reduce speed to 10 kn or less for at least 24 hours when a North Atlantic right whale is sighted at any distance by any project-related personnel or acoustically detected by any project-related PAM system. Each subsequent observation or acoustic detection in the Project area shall trigger an additional 24-hour period. If a North Atlantic right whale is reported via any of the monitoring systems (see (b)(4) of this section) within 10 kilometers (km; 6.2 miles (mi)) of a transiting vessel(s), that vessel must operate at 10 knots (kn; 11.5 miles per hour (mph)) or less for 24 hours following the reported detection;

(7) LOA Holder's vessels, regardless of size, must immediately reduce speed to 10 kn or less when any large whale (other than a North Atlantic right whale) is observed within 500 meters (m; 1,640 ft (ft)) of an underway vessel;

(8) If LOA Holder's vessel(s) are traveling at speeds greater than 10 kn (*i.e.*, no speed restrictions are enacted) in a transit corridor from a port to the Lease Area, in addition to the required dedicated visual observer, LOA Holder must monitor the transit corridor in real-time with PAM prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kn or less for 24 hours following the detection. Each subsequent detection shall trigger a 24-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 24 hours;

(9) LOA Holder's vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kn or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale is sighted within 500 m of an

underway vessel, that vessel must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take the vessel strike avoidance measures described in this paragraph (b)(9);

(10) LOA Holder's vessels must maintain a minimum separation distance of 100 m (328 ft) from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of a transiting vessel, LOA Holder's vessel must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 100 m;

(11) LOA Holder's vessels must maintain a minimum separation distance of 50 m (164 ft) from all delphinoid cetaceans and pinnipeds with an exception made for those that approach the vessel (*i.e.*, bow-riding dolphins). If a delphinid cetacean or pinniped is sighted within 50 m of a transiting vessel, LOA Holder's vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.*, bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m;

(12) When a marine mammal(s) is sighted while LOA Holder's vessel(s) is transiting, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.*, attempt to remain parallel to the animal's course, slow down, and avoid abrupt changes in direction until the animal has left the area). This measure does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.*, any situation where the vessel is navigationally constrained);

(13) LOA Holder's vessels underway must not divert or alter course to approach any marine mammal. If a separation distance is triggered, any vessel underway must avoid abrupt changes in course direction and transit at 10 kn or less until the animal is outside the relevant separation distance;

(14) LOA Holder is required to abide by other speed and approach regulations. Nothing in this subpart exempts vessels from any other applicable marine mammal speed and approach regulations;

(15) LOA Holder must check, daily, for information regarding the establishment of mandatory or voluntary vessel strike avoidance areas (*i.e.*, DMAs, SMAs, Slow Zones) and any information regarding North Atlantic right whale sighting locations;

(16) LOA Holder must submit a North Atlantic Right Whale Vessel Strike Avoidance Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to the planned start of vessel activity. The plan must provide details on the vessel-based observer and PAM protocols for transiting vessels. If a plan is not submitted or approved by NMFS prior to vessel operations, all project vessels transiting, year round, must travel at speeds of 10-kn or less. LOA Holder must comply with any approved North Atlantic Right Whale Vessel Strike Avoidance Plan; and

(17) Speed over ground will be used to measure all vessel speed restrictions.

(c) *WTG, OSS, Met Tower foundation installation*. The following requirements apply to impact pile driving activities associated with the installation of WTG, OSS, and Met Tower foundations:

(1) Impact pile driving must not occur January 1 through April 30. Impact pile driving must be avoided to the maximum extent practicable in December; however, it may occur if necessary to complete the project with prior approval by NMFS;

(2) Monopiles must be no larger than 15 m in diameter, representing the larger end of the monopile design. During all monopile installation, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,400 kilojoules for monopile installation. No more than two monopiles may be installed per day. Pin piles must be no larger than 5 m in diameter. During all pin pile installation, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 2,500 kJ for pin pile installation. No more than four pin piles may be installed per day;

(3) LOA Holder must not initiate pile driving earlier than 1 hour prior to civil sunrise or later than 1.5 hours prior to civil sunset, unless the LOA Holder submits, and NMFS approves, an Alternative Monitoring Plan as part of the Pile Driving and Marine Mammal Monitoring Plan that reliably demonstrates the efficacy of their night vision devices;

(4) LOA Holder must utilize a soft-start protocol for each impact pile driving event of all foundations by performing four to six strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes;

(5) Soft-start must occur at the beginning of impact driving and at any time following a cessation of impact pile driving of 30 minutes or longer;

(6) LOA Holder must establish clearance and shutdown zones, which must be measured using the radial distance around the pile being driven. If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving must be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings. The specific time periods are 15 minutes for odontocetes (excluding sperm whales) and pinnipeds, and 30 minutes for all other species;

(7) For North Atlantic right whales, any visual observation or acoustic detection must trigger a delay to the commencement of pile driving. The clearance zone may only be declared clear if no North Atlantic right whale acoustic or visual detections have occurred within the clearance zone during the 60-minute monitoring period;

(8) LOA Holder must deploy at least two fully functional, uncompromised noise abatement systems that reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving:

(i) A single bubble curtain must not be used;

(ii) Any bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 m^3/(minute*m). The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must adjust the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved;

(iii) The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact;

(iv) No parts of the ring or other objects may prevent full seafloor contact with a bubble curtain ring;

(v) Construction contractors must train personnel in the proper balancing of airflow to the bubble curtain ring. LOA Holder must provide NMFS Office of Protected Resources with a bubble curtain performance test and maintenance report to review within 72 hours after each pile using a bubble curtain is installed. Additionally, a full maintenance check (*e.g.*, manually clearing holes) must occur prior to each pile being installed;

(vi) Corrections to the bubble ring(s) to meet the performance standards in this paragraph (c)(8) must occur prior to impact pile driving of monopiles and pin piles. If LOA Holder uses a noise mitigation device in addition to the bubble curtain, LOA Holder must maintain similar quality control measures as described in this paragraph (c)(8).

(9) LOA Holder must utilize NMFS-approved PAM systems, as described in paragraph (c)(16) of this section. The PAM system components (*i.e.*, acoustic buoys) must not be placed closer than 1 km to the pile being driven so that the activities do not mask the PAM system. LOA Holder must provide an adequate demonstration of and justification for the detection range of the system they plan to deploy while considering potential masking from concurrent pile-driving and vessel noise. The PAM system must be able to detect a vocalization of North Atlantic right whales up to 10 km (6.2 mi).

(10) LOA Holder must utilize PSO(s) and PAM operator(s), as described in § 217.305(c). At least three on-duty PSOs must be on the pile driving platform. Additionally, two dedicated-PSO vessels must be used at least 60 minutes before, during, and 30 minutes after all pile driving, and each dedicated-PSO vessel must have at-least three PSOs on duty during these time periods. LOA Holder may request NMFS approval to use alternative technology (*e.g.*, drones) in lieu of one or two of the dedicated PSO vessels that provide similar marine mammal detection capabilities.

(11) If a marine mammal is detected (visually or acoustically) entering or within the respective shutdown zone after pile driving has begun, the PSO or PAM operator must call for a shutdown of pile driving and LOA Holder must stop pile driving immediately, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk of injury or loss of life for individuals, or the lead engineer determines there is pile refusal or pile instability. If pile driving is not shut down in one of these situations, LOA Holder must reduce hammer energy to the lowest level practicable and the reason(s) for not shutting down must be documented and reported to NMFS Office of Protected Resources within the applicable monitoring reports (*e.g.*, weekly, monthly).

(12) Any visual observation at any distance or acoustic detection within the PAM monitoring zone of a North Atlantic right whale triggers shutdown requirements under paragraph (c)(11) of this subsection. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale has neither been visually or acoustically detected for 30 minutes;

(13) If pile driving has been shut down due to the presence of a marine mammal other than a North Atlantic right whale, pile driving must not restart until either the marine mammal(s) has voluntarily left the specific shutdown zones and has been visually or acoustically confirmed beyond that shutdown zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for odontocetes (excluding sperm whales) and pinnipeds, and 30 minutes for all other marine mammal species. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time LOA Holder must use the lowest hammer energy practicable to maintain stability;

(14) LOA Holder must conduct sound field verification (SFV) measurements during pile driving activities associated with the installation of, at minimum, the first three monopile foundations and/or the first three full jacket foundations (inclusive of all pin piles for a specific

jacket foundation). SFV measurements must continue until at least three consecutive monopiles and three entire jacket foundations demonstrate noise levels are at or below those modeled, assuming 10-decibels (dB) of attenuation. Subsequent SFV measurements are also required should larger piles be installed or if additional piles are driven that may produce louder sound fields than those previously measured (*e.g.*, higher hammer energy, greater number of strikes). SFV measurements must be conducted as follows:

(i) Measurements must be made at a minimum of four distances from the pile(s) being driven, along a single transect, in the direction of lowest transmission loss (*i.e.*, projected lowest transmission loss coefficient), including, but not limited to, 750 m (2,460 ft) and three additional ranges selected such that measurement of Level A harassment and Level B harassment isopleths are accurate, feasible, and avoids extrapolation. At least one additional measurement at an azimuth 90 degrees from the array at 750 m must be made. At each location, there must be a near bottom and mid-water column hydrophone (measurement systems);

(ii) The recordings must be continuous throughout the duration of all pile driving of each foundation;

(iii) The SFV measurement systems must have a sensitivity appropriate for the expected sound levels from pile driving received at the nominal ranges throughout the installation of the pile. The frequency range of SFV measurement systems must cover the range of at least 20 hertz (Hz) to 20 kilohertz (kHz). The SFV measurement systems must be designed to have omnidirectional sensitivity so that the broadband received level of all pile driving exceeds the system noise floor by at least 10 dB. The dynamic range of the SFV measurement system must be sufficient such that at each location, the signals avoid poor signal-to-noise ratios for low amplitude signals and avoid clipping, nonlinearity, and saturation for high amplitude signals;

(iv) All hydrophones used in SFV measurements systems are required to have undergone a full system, traceable laboratory calibration conforming to International Electrotechnical Commission (IEC) 60565, or an equivalent standard procedure, from a factory or accredited source to ensure the hydrophone receives accurate sound levels, at a date not to exceed 2 years before deployment. Additional *in-situ* calibration checks using a pistonphone are required to be performed before and after each hydrophone deployment. If the measurement system employs filters via hardware or software (*e.g.*, high-pass, low-pass, *etc*.), which is not already accounted for by the calibration, the filter performance (*i.e.*, the filter's frequency response) must be known, reported, and the data corrected before analysis.

(v) LOA Holder must be prepared with additional equipment (*e.g.*, hydrophones, recording devices, hydrophone calibrators, cables, batteries), which exceeds the amount of equipment necessary to perform the measurements, such that technical issues can be mitigated before measurement;

(vi) LOA Holder must submit 48-hour interim reports after each foundation is measured (see § 217.305(g) section for interim and final reporting requirements);

(vii) LOA Holder must not exceed modeled distances to NMFS marine mammal Level A harassment and Level B harassment thresholds assuming 10-dB attenuation, for foundation installation. If any of the interim SFV measurement reports submitted for the first three monopiles indicate the modeled distances to NMFS marine mammal Level A harassment and Level B harassment thresholds assuming 10-dB attenuation, then LOA Holder must implement additional sound attenuation measures on all subsequent foundations. LOA Holder must also increase clearance and shutdown zone sizes to those identified by NMFS until SFV measurements on at least three additional foundations demonstrate acoustic distances to harassment thresholds meet or are less than those modeled assuming 10-dB of attenuation. LOA Holder must operate fully functional sound attenuation systems (*e.g.*, ensure hose maintenance, pressure testing) to meet noise levels modeled, assuming 10-dB attenuation, within three piles or else foundation installation activities must cease until NMFS and LOA Holder can evaluate the situation and ensure future piles must not exceed noise levels modeled assuming 10-dB attenuation;

(viii) If, after additional measurements conducted pursuant to requirements of paragraph (c)(15)(vii), acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10-dB attenuation), LOA Holder may request to NMFS Office of Protected Resources a modification of the clearance and shutdown zones. For NMFS Office of Protected Resources to consider a modification request for reduced zone sizes, LOA Holder must have conducted SFV measurements on an additional three foundations (for either/or monopile and jackets) and ensure that subsequent foundations would be installed under conditions that are predicted to produce smaller harassment zones than those modeled assuming 10-dB of attenuation;

(ix) LOA Holder must conduct SFV measurements upon commencement of turbine operations to estimate turbine operational source levels, in accordance with a NMFS-approved Foundation Installation Pile Driving SFV Plan. SFV must be conducted in the same manner as previously described in § 217.304(c)(14), with appropriate adjustments to measurement distances, number of hydrophones, and hydrophone sensitivities being made, as necessary; and

(x) LOA Holder must submit a SFV Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of foundation installation activities and abide by the Plan if approved. At minimum, the SFV Plan must describe how LOA Holder would ensure that the first three monopile foundation/entire jacket foundation (inclusive of all pin piles for a jacket foundation) installation sites selected for SFV measurements are representative of the rest of the monopile and/or jacket foundation installation sites such that future pile installation events are anticipated to produce similar sound levels to those piles measured. In the case that these sites/scenarios are not determined to be representative of all other pile installation sites, LOA Holder must include information in the SFV Plan on how additional sites/scenarios would be selected for SFV measurements. The SFV Plan must also include methodology for collecting, analyzing, and preparing SFV measurement data for submission to NMFS Office of Protected Resources and describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. SFV for pile driving may not occur until NMFS approves the SFV Plan for this activity.

(16) LOA Holder must submit a Foundation Installation Pile Driving Marine Mammal Monitoring Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of pile driving and abide by the Plan if approved. LOA Holder must obtain both NMFS Office of Protected Resources and NMFS Greater Atlantic Regional Fisheries Office Protected Resources Division’s concurrence with this Plan prior to the start of any pile driving. The Plan must include a description of all monitoring equipment and PAM and PSO protocols (including number and location of PSOs) for all pile driving. No foundation pile installation can occur without NMFS’ approval of the Plan; and

(17) LOA Holder must submit a Passive Acoustic Monitoring Plan (PAM Plan) to NMFS Office of Protected Resources for review and approval at least 180 days prior to the planned start of foundation installation activities (impact pile driving) and abide by the Plan if approved. The PAM Plan must include a description of all proposed PAM equipment, address how the proposed

passive acoustic monitoring must follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind as described in *NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs* (2021). The Plan must describe all proposed PAM equipment, procedures, and protocols including proof that vocalizing North Atlantic right whales will be detected within the clearance and shutdown zones. No pile installation can occur if LOA Holder's PAM Plan does not receive approval from NMFS Office of Protected Resources and NMFS Greater Atlantic Regional Fisheries Office Protected Resources Division.

(d) *Cofferdam installation and removal.* The following requirements apply to the installation and removal of cofferdams at the cable landfall construction sites:

(1) Installation and removal of cofferdams must not occur during nighttime hours (defined as the hours between 1.5 hours prior to civil sunset and 1 hour after civil sunrise);

(2) All installation and removal of sheet piles for cofferdams must only occur for up to 8 hours per day (within a single 24-hour period);

(3) LOA Holder must establish and implement clearance zones for the installation and removal of cofferdams using visual monitoring. These zones must be measured using the radial distance from the cofferdam being installed and/or removed;

(4) LOA Holder must utilize PSO(s), as described in § 217.305(d). At least two on-duty PSOs must monitor for marine mammals at least 30 minutes before, during, and 30 minutes after vibratory pile driving associated with cofferdam and casing pipe installation; and

(5) If a marine mammal is observed entering or within the respective shutdown zone after vibratory pile driving has begun, the PSO must call for a shutdown of vibratory pile driving. LOA Holder must stop vibratory pile driving immediately unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual or if there is a risk of damage to the vessel that would create a risk of injury or loss of life for individuals or if the lead engineer determines there is refusal or instability. In any of these situations, LOA Holder must document the reason(s) for not shutting down and report the information to NMFS Office of Protected Resources in the next available weekly report (as described in § 217.305(h)).

(e) *HRG surveys*. The following requirements apply to HRG surveys operating sub-bottom profilers (SBPs) (*i.e.*, boomers, sparkers, and Compressed High Intensity Radiated Pulse (CHIRPS)):

(1) LOA Holder must establish and implement clearance and shutdown zones for HRG surveys using visual monitoring, as described in § 217.305(f) of this section;

(2) LOA Holder must utilize PSO(s), as described in § 217.305(e);

(3) LOA Holder must abide by the relevant Project Design Criteria (PDCs 4, 5, and 7) of the programmatic consultation completed by NMFS' Greater Atlantic Regional Fisheries Office on June 29, 2021 (revised September 2021), pursuant to section 7 of the Endangered Species Act (ESA). To the extent that any relevant Best Management Practices (BMPs) described in these PDCs are more stringent than the requirements herein, those BMPs supersede these requirements;

(4) SBPs (hereinafter referred to as "acoustic sources") must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Acoustic sources must be used at the lowest practicable source level to meet the survey objective, when in use, and must be turned off when they are not necessary for the survey;

(5) LOA Holder is required to ramp-up acoustic sources prior to commencing full power, unless the equipment operates on a binary on/off switch, and ensure visual clearance zones are fully visible (*e.g.*, not obscured by darkness, rain, fog) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using acoustic sources specified in the LOA;

(6) Prior to a ramp-up procedure starting or activating acoustic sources, the acoustic source operator (operator) must notify a designated PSO of the planned start of ramp-up as agreed upon with the Lead PSO. The notification time should not be less than 60 minutes prior to the planned ramp-up or activation in order to allow the PSOs time to monitor the clearance zone(s) for 30 minutes prior to the initiation of ramp-up or activation (pre-start clearance). During this 30-minute pre-start clearance period, the entire applicable clearance zones must be visible, except as indicated in paragraph (e)(12) of this section;

(7) Ramp-ups must be scheduled so as to minimize the time spent with the source activated;

(8) A PSO conducting pre-start clearance observations must be notified again immediately prior to reinitiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed;

(9) LOA Holder must implement a 30-minute clearance period of the clearance zones immediately prior to the commencing of the survey or when there is more than a 30-minute break in survey activities or PSO monitoring. A clearance period is a period when no marine mammals are detected in the relevant zone;

(10) If a marine mammal is observed within a clearance zone during the clearance period, ramp-up of acoustic sources may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sighting. The specific time period is 15 minutes for odontocetes (excluding sperm whales) and pinnipeds, and 30 minutes for all other species;

(11) In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (infrared (IR)/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations are allowed to commence (*i.e.*, no delay is required) despite periods of inclement weather and/or loss of daylight. Ramp-up may occur at times of poor visibility, including nighttime, if appropriate visual monitoring has occurred with no detections of marine mammals in the 30 minutes prior to beginning ramp-up;

(12) Once the survey has commenced, LOA Holder must shut down acoustic sources if a marine mammal enters a respective shutdown zone. In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations are allowed to continue (*i.e.*, no shutdown is required) so long as no marine mammals have been detected. The shutdown requirement does not apply to small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus*, and *Tursiops*. If there is uncertainty regarding the identification of a marine mammal species (*i.e.*, whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified in this paragraph (e)(12) of this section is detected in the shutdown zone;

(13) If an acoustic source has been shut down due to the presence of a marine mammal, the use of an acoustic source may not commence or resume until the animal(s) has been

confirmed to have left the Level B harassment zone or until a full 15 minutes (for odontocetes (excluding sperm whales) and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting;

(14) LOA Holder must immediately shut down any acoustic source if a marine mammal is sighted entering or within its respective shutdown zones. If there is uncertainty regarding the identification of a marine mammal species (*i.e.*, whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified in paragraph (e)(13) of this section is detected in the shutdown zone; and

(15) If an acoustic source is shut down for a period longer than 30 minutes, all clearance and ramp-up procedures must be initiated. If an acoustic source is shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for less than 30 minutes, acoustic sources may be activated again without ramp-up only if PSOs have maintained constant observation and no additional detections of any marine mammal occurred within the respective shutdown zones.

(f) *Fisheries monitoring surveys*. The following measures apply to fishery monitoring surveys:

(1) Survey gear must be deployed as soon as possible once the vessel arrives on station. Gear must not be deployed if there is a risk of interaction with marine mammals. Gear may be deployed after 15 minutes of no marine mammal sightings within 1 nautical mile (nmi; 1,852 m) of the sampling station;

(2) LOA Holder and/or its cooperating institutions, contracted vessels, or commercially hired captains must implement the following "move-on" rule: if marine mammals are sighted within 1 nmi of the planned location and 15 minutes before gear deployment, then LOA Holder and/or its cooperating institutions, contracted vessels, or commercially hired captains, as appropriate, must move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, LOA Holder and its cooperating institutions, contracted vessels, or commercially hired captains must move again or skip the station;

(3) If a marine mammal is deemed to be at risk of interaction after the gear is deployed or set, all gear must be immediately removed from the water. If marine mammals are sighted before the gear is fully removed from the water, the vessel must slow its speed and maneuver the vessel away from the animals to minimize potential interactions with the observed animal;

(4) LOA Holder must maintain visual marine mammal monitoring effort during the entire period of time that gear is in the water (*i.e.*, throughout gear deployment, fishing, and retrieval);

(5) All fisheries monitoring gear must be fully cleaned and repaired (if damaged) before each use/deployment;

(6) LOA Holder's fixed gear must comply with the Atlantic Large Whale Take Reduction Plan regulations at 50 CFR 229.32 during fisheries monitoring surveys;

(7) Trawl tows must be limited to a maximum of a 20-minute trawl time at 3.0 kn;

(8) All gear must be emptied as close to the deck/sorting area and as quickly as possible after retrieval;

(9) During trawl surveys, vessel crew must open the codend of the trawl net close to the deck in order to avoid injury to animals that may be caught in the gear;

(10) All fishery survey-related lines must include the breaking strength of all lines being less than 1,700 pounds (lbs; 771 kilograms (kg)). This may be accomplished by using whole

buoy line that has a breaking strength of 1,700 lbs; or buoy line with weak inserts that result in line having an overall breaking strength of 1,700 lbs;

(11) During any survey that uses vertical lines, buoy lines must be weighted and must not float at the surface of the water and all groundlines must consist of sinking lines. All groundlines must be composed entirely of sinking lines. Buoy lines must utilize weak links. Weak links must break cleanly leaving behind the bitter end of the line. The bitter end of the line must be free of any knots when the weak link breaks. Splices are not considered to be knots. The attachment of buoys, toggles, or other floatation devices to groundlines is prohibited;

(12) All in-water survey gear, including buoys, must be properly labeled with the scientific permit number or identification as LOA Holder’s research gear. All labels and markings on the gear, buoys, and buoy lines must also be compliant with the Atlantic Large Whale Take Reduction Plan regulations at 50 CFR 229.32, and all buoy markings must comply with instructions received by the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division;

(13) All survey gear must be removed from the water whenever not in active survey use (*i.e.*, no wet storage); and

(14) All reasonable efforts that do not compromise human safety must be undertaken to recover gear.

§ 217.305 Monitoring and reporting requirements.

(a) *Protected species observer (PSO) and passive acoustic monitoring (PAM) operator qualifications.* LOA Holder must implement the following measures applicable to PSOs and PAM operators:

(1) LOA Holder must use independent, NMFS-approved PSOs and PAM operators, meaning that the PSOs and PAM operators must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant crew with regard to the presence of protected species and mitigation requirements;

(2) All PSOs and PAM operators must have successfully attained a bachelor’s degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO or PAM operator has acquired the relevant skills through a suitable amount of alternate experience. Requests for such a waiver must be submitted to NMFS Office of Protected Resources and must include written justification containing alternative experience. Alternate experience that may be considered includes, but is not limited to: previous work experience conducting academic, commercial, or government-sponsored marine mammal visual and/or acoustic surveys; or previous work experience as a PSO/PAM operator;

(3) PSOs must have visual acuity in both eyes (with correction of vision being permissible) sufficient enough to discern moving targets on the water’s surface with the ability to estimate the target size and distance (binocular use is allowable); ability to conduct field observations and collect data according to the assigned protocols; sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations; writing skills sufficient to document observations, including but not limited to, the number and species of marine mammals observed, the dates and times when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental take of marine mammals from construction noise within a defined

shutdown zone, and marine mammal behavior; and the ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area;

(4) All PSOs must be trained in northwestern Atlantic Ocean marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations (as described in § 217.305(b)(6) and § 217.305(b)(7));

(5) All PSOs and PAM operators must successfully complete a relevant training course within the last 5 years, including obtaining a certificate of course completion;

(6) PSOs and PAM operators are responsible for obtaining NMFS' approval. NMFS may approve PSOs and PAM operators as conditional or unconditional. A conditionally-approved PSO or PAM operator may be one who has completed training in the last 5 years but has not yet attained the requisite field experience. An unconditionally approved PSO or PAM operator is one who has completed training within the last 5 years and attained the necessary experience (*i.e.*, demonstrate experience with monitoring for marine mammals at clearance and shutdown zone sizes similar to those produced during the respective activity). Lead PSO or PAM operators must be unconditionally approved and have a minimum of 90 days in an northwestern Atlantic Ocean offshore environment performing the role (either visual or acoustic), with the conclusion of the most recent relevant experience not more than 18 months previous. A conditionally approved PSO or PAM operator must be paired with an unconditionally approved PSO or PAM operator;

(7) PSOs for cable landfall construction (*i.e.*, vibratory pile installation and removal) and HRG surveys may be unconditionally or conditionally approved. PSOs and PAM operators for foundation installation activities must be unconditionally approved;

(8) At least one on-duty PSO and PAM operator, where applicable, for each activity (*e.g.*, impact pile driving, vibratory pile driving, and HRG surveys) must be designated as the Lead PSO or Lead PAM operator;

(9) LOA Holder must submit NMFS previously approved PSOs and PAM operators to NMFS Office of Protected Resources for review and confirmation of their approval for specific roles at least 30 days prior to commencement of the activities requiring PSOs/PAM operators or 15 days prior to when new PSOs/PAM operators are required after activities have commenced;

(10) For prospective PSOs and PAM operators not previously approved, or for PSOs and PAM operators whose approval is not current, LOA Holder must submit resumes for approval at least 60 days prior to PSO and PAM operator use. Resumes must include information related to relevant education, experience, and training, including dates, duration, location, and description of prior PSO or PAM operator experience. Resumes must be accompanied by relevant documentation of successful completion of necessary training;

(11) PAM operators are responsible for obtaining NMFS approval. To be approved as a PAM operator, the person must meet the following qualifications: The PAM operator must demonstrate that they have prior experience with real-time acoustic detection systems and/or have completed specialized training for operating PAM systems and detecting and identifying Atlantic Ocean marine mammals sounds, in particular: North Atlantic right whale sounds, humpback whale sounds, and how to deconflict them from similar North Atlantic right whale sounds, and other co-occurring species' sounds in the area including sperm whales; must be able to distinguish between whether a marine mammal or other species sound is detected, possibly detected, or not detected, and similar terminology must be used across companies/projects;

Where localization of sounds or deriving bearings and distance are possible, the PAM operators need to have demonstrated experience in using this technique; PAM operators must be independent observers (*i.e.*, not construction personnel); PAM operators must demonstrate experience with relevant acoustic software and equipment; PAM operators must have the qualifications and relevant experience/training to safely deploy and retrieve equipment and program the software, as necessary; PAM operators must be able to test software and hardware functionality prior to operation; and PAM operators must have evaluated their acoustic detection software using the PAM Atlantic baleen whale annotated data set available at National Centers for Environmental Information (NCEI) and provide evaluation/performance metric;

(12) PAM operators must be able to review and classify acoustic detections in real-time (prioritizing North Atlantic right whales and noting detection of other cetaceans) during the real-time monitoring periods;

(13) PSOs may work as PAM operators and vice versa, pending NMFS-approval; however, they may only perform one role at any one time and must not exceed work time restrictions, which must be tallied cumulatively; and

(14) All PSOs and PAM operators must complete a Permits and Environmental Compliance Plan training and a 2-day refresher session that must be held with the PSO provider and Project compliance representative(s) prior to the start of in-water project activities (*e.g.*, HRG survey, foundation installation, cable landfall activities, *etc*.).

(b) *General PSO and PAM operator requirements.* The following measures apply to PSOs and PAM operators and must be implemented by LOA Holder:

(1) PSOs must monitor for marine mammals prior to, during, and following impact pile driving, vibratory pile driving, and HRG surveys that use sub-bottom profilers (with specific monitoring durations and needs described in paragraphs (c) through (f) of this section, respectively). Monitoring must be done while free from distractions and in a consistent, systematic, and diligent manner;

(2) For foundation installation, PSOs must visually clear (*i.e.*, confirm no observations of marine mammals) the entire minimum visibility zone for a full 30 minutes immediately prior to commencing activities. For cable landfall activities (*e.g.*, cofferdams) and HRG surveys, which do not have a minimum visibility zone, the entire clearance zone must be visually cleared and as much of the Level B harassment zone as possible;

(3) All PSOs must be located at the best vantage point(s) on any platform, as determined by the Lead PSO, in order to obtain 360-degree visual coverage of the entire clearance and shutdown zones around the activity area, and as much of the Level B harassment zone as possible. PAM operators may be located on a vessel or remotely on-shore, the PAM operator(s) must assist PSOs in ensuring full coverage of the clearance and shutdown zones. The PAM operator must monitor to and past the clearance zone for large whales;

(4) All on-duty PSOs must remain in real-time contact with the on-duty PAM operator(s), PAM operators must immediately communicate all acoustic detections of marine mammals to PSOs, including any determination regarding species identification, distance, and bearing (where relevant) relative to the pile being driven and the degree of confidence (*e.g.*, possible, probable detection) in the determination. All on-duty PSOs and PAM operator(s) must remain in contact with the on-duty construction personnel responsible for implementing mitigations (*e.g.*, delay to pile driving) to ensure communication on marine mammal observations can easily, quickly, and consistently occur between all on-duty PSOs, PAM operator(s), and on-water Project personnel;

(5) The PAM operator must inform the Lead PSO(s) on duty of animal detections approaching or within applicable ranges of interest to the activity occurring via the data collection software system (*i.e.*, Mysticetus or similar system) who must be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.*, delay);

(6) PSOs must use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During foundation installation, at least two PSOs on the pile driving-dedicated PSO vessel must be equipped with functional Big Eye binoculars (*e.g.*, 25 x 150; 2.7 view angle; individual ocular focus; height control); these must be pedestal mounted on the deck at the best vantage point that provides for optimal sea surface observation and PSO safety. PAM operators must have the appropriate equipment (*i.e.*, a computer station equipped with a data collection software system available wherever they are stationed) and use a NMFS-approved PAM system to conduct monitoring. PAM systems are approved through the PAM Plan as described in § 217.304(c)(17);

(7) During periods of low visibility (*e.g.*, darkness, rain, fog, poor weather conditions, *etc*.), PSOs must use alternative technology (*i.e.*, infrared or thermal cameras) to monitor the clearance and shutdown zones as approved by NMFS; and

(8) PSOs and PAM operators must not exceed 4 consecutive watch hours on duty at any time, must have a 2-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period. If the schedule includes PSOs and PAM operators on-duty for 2-hour shifts, a minimum 1-hour break between watches must be allowed.

(c) *PSO and PAM operator requirements during WTG, OSS, and Met Tower foundation installation*. The following measures apply to PSOs and PAM operators during WTG, OSS, and Met Tower foundation installation and must be implemented by LOA Holder:

(1) PSOs and PAM operator(s), using a NMFS-approved PAM system, must monitor for marine mammals 60 minutes prior to, during, and 30 minutes following all pile-driving activities. If PSOs cannot visually monitor the minimum visibility zone prior to impact pile driving at all times using the equipment described in paragraphs (b)(6) and (7) of this section, pile-driving operations must not commence or must shutdown if they are currently active;

(2) At least three on-duty PSOs must be stationed and observing from the activity platform during impact pile driving and at least three on-duty PSOs must be stationed on each dedicated PSO vessel. Concurrently, at least one PAM operator per acoustic data stream (equivalent to the number of acoustic buoys) must be actively monitoring for marine mammals 60 minutes before, during, and 30 minutes after impact pile driving in accordance with a NMFS-approved PAM Plan;

(3) LOA Holder must conduct PAM for at least 24 hours immediately prior to pile driving activities. The PAM operator must review all detections from the previous 24-hour period immediately prior to pile driving activities.

(d) *PSO requirements during cofferdam installation and removal*. The following measures apply to PSOs during cofferdam installation and removal and must be implemented by LOA Holder:

(1) At least two PSOs must be on active duty during all activities related to the installation and removal of cofferdams; and

(2) PSOs must monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles, and for 30 minutes after all

vibratory pile driving activities have ceased. Sheet pile installation must only commence when visual clearance zones are fully visible (*e.g.*, not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of vibratory pile driving.

(e) *PSO requirements during HRG surveys*. The following measures apply to PSOs during HRG surveys using acoustic sources that have the potential to result in harassment and must be implemented by LOA Holder:

(1) Between four and six PSOs must be present on every 24-hour survey vessel and two to three PSOs must be present on every 12-hour survey vessel;

(2) At least one PSO must be on active duty monitoring during HRG surveys conducted during daylight (*i.e.*, from 30 minutes prior to civil sunrise through 30 minutes following civil sunset) and at least two PSOs must be on activity duty monitoring during HRG surveys conducted at night;

(3) PSOs on HRG vessels must begin monitoring 30 minutes prior to activating acoustic sources, during the use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased;

(4) Any observations of marine mammals must be communicated to PSOs on all nearby survey vessels during concurrent HRG surveys; and

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

(f) *Monitoring requirements during fisheries monitoring surveys*. The following measures apply during fisheries monitoring surveys and must be implemented by LOA Holder:

(1) All captains and crew conducting fishery surveys must be trained in marine mammal detection and identification; and

(2) Marine mammal monitoring must be conducted within 1 nmi from the planned survey location by the trained captain and/or a member of the scientific crew for 15 minutes prior to deploying gear, throughout gear deployment and use, and for 15 minutes after haul back.

(g) *Reporting*. LOA Holder must comply with the following reporting measures:

(1) Prior to initiation of any on-water project activities, LOA Holder must demonstrate in a report submitted to NMFS Office of Protected Resources that all required training for LOA Holder personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed.

(2) LOA Holder must use a standardized reporting system during the effective period of the LOAs. All data collected related to the Project must be recorded using industry-standard software that is installed on field laptops and/or tablets. Unless stated otherwise, all reports must be submitted to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov*), dates must be in MM/DD/YYYY format, and location information must be provided in Decimal Degrees and with the coordinate system information (*e.g.*, NAD83, WGS84, *etc*.).

(3) For all visual monitoring efforts and marine mammal sightings, the following information must be collected and reported to NMFS Office of Protected Resources: the date and time that monitored activity begins or ends; the construction activities occurring during each observation period; the watch status (*i.e.*, sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform); the PSO who sighted the animal; the time of sighting; the weather parameters (*e.g.*, wind speed, percent cloud cover, visibility); the water conditions (*e.g.*,

Beaufort sea state, tide state, water depth); all marine mammal sightings, regardless of distance from the construction activity; species (or lowest possible taxonomic level possible); the pace of the animal(s); the estimated number of animals (minimum/maximum/high/low/best); the estimated number of animals by cohort (*e.g.*, adults, yearlings, juveniles, calves, group composition, *etc*.); the description (*i.e.*, as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics); the description of any marine mammal behavioral observations (*e.g.*, observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity; the animal's closest distance and bearing from the pile being driven or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zone(s); the activity at time of sighting (*e.g.*, vibratory installation/removal, impact pile driving, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.*, ramp-up of HRG equipment, HRG acoustic source on/off, soft-start for pile driving, active pile driving, *etc*.); the marine mammal occurrence in Level A harassment or Level B harassment zones; the description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.*, delay, shutdown, *etc*.) and time and location of the action; other human activity in the area, and; other applicable information, as required in any LOAs issued under § 217.306.

(4) LOA Holder must compile and submit weekly reports during foundation installation to NMFS Office of Protected Resources that document the daily start and stop of all pile driving associated with the Project; the start and stop of associated observation periods by PSOs; details on the deployment of PSOs; a record of all detections of marine mammals (acoustic and visual); any mitigation actions (or if mitigation actions could not be taken, provide reasons why); and details on the noise attenuation system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday to Saturday) and must include the information required under this section. The weekly report must also identify which turbines become operational and when (a map must be provided). Once all foundation pile installation is completed, weekly reports are no longer required by LOA Holder.

(5) LOA Holder must compile and submit monthly reports to NMFS Office of Protected Resources during foundation installation that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, MMIS number, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The monthly report must also identify which turbines become operational and when (a map must be provided). Full PAM detection data and metadata must also be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic Right Whale Passive Acoustic Reporting System website at *https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*.

(6) LOA Holder must submit a draft annual report to NMFS Office of Protected Resources no later than 90 days following the end of a given calendar year. LOA Holder must provide a final report within 30 days following resolution of NMFS' comments on the draft report. The draft and final reports must detail the following: the total number of marine mammals of each species/stock detected and how many were within the designated Level A harassment and Level B harassment zone(s) with comparison to authorized take of marine mammals for the associated activity type; marine mammal detections and behavioral observations before, during,

and after each activity; what mitigation measures were implemented (*i.e.*, number of shutdowns or clearance zone delays, *etc*.) or, if no mitigative actions was taken, why not; operational details (*i.e.*, days and duration of impact and vibratory pile driving, days, and amount of HRG survey effort, *etc*.); any PAM systems used; the results, effectiveness, and which noise attenuation systems were used during relevant activities (*i.e.*, impact pile driving); summarized information related to situational reporting; and any other important information relevant to the Project, including additional information that may be identified through the adaptive management process.

(7) LOA Holder must submit its draft 5-year report to NMFS Office of Protected Resources on all visual and acoustic monitoring conducted within 90 calendar days of the completion of activities occurring under the LOAs. A 5-year report must be prepared and submitted within 60 calendar days following receipt of any NMFS Office of Protected Resources comments on the draft report. If no comments are received from NMFS Office of Protected Resources within 60 calendar days of NMFS Office of Protected Resources receipt of the draft report, the report shall be considered final.

(8) For those foundation piles requiring SFV measurements, LOA Holder must provide the initial results of the SFV measurements to NMFS Office of Protected Resources in an interim report after each foundation installation event as soon as they are available and prior to a subsequent foundation installation, but no later than 48 hours after each completed foundation installation event. The report must include, at minimum: hammer energies/schedule used during pile driving, including, the total number of strikes and the maximum hammer energy; the model-estimated acoustic ranges ($R_{95\%}$) to compare with the real-world sound field measurements; peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), and sound exposure level (SEL, in single strike for pile driving, $SEL_{ss,}$), for each hydrophone, including at least the maximum, arithmetic mean, minimum, median (L50) and L5 (95 percent exceedance) statistics for each metric; estimated marine mammal Level A harassment and Level B harassment isopleths, calculated using the maximum-over-depth L5 (95 percent exceedance level, maximum of both hydrophones) of the associated sound metric; comparison of modeled results assuming 10-dB attenuation against the measured marine mammal Level A harassment and Level B harassment acoustic isopleths; estimated transmission loss coefficients; pile identifier name, location of the pile and each hydrophone array in latitude/longitude; depths of each hydrophone; one-third-octave band single strike SEL spectra; if filtering is applied, full filter characteristics must be reported; and hydrophone specifications including the type, model, and sensitivity. LOA Holder must also report any immediate observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices. If any *in-situ* calibration checks for hydrophones reveal a calibration drift greater than 0.75 dB, pistonphone calibration checks are inconclusive, or calibration checks are otherwise not effectively performed, LOA Holder must indicate full details of the calibration procedure, results, and any associated issues in the 48-hour interim reports.

(9) The final results of SFV measurements from each foundation installation must be submitted as soon as possible, but no later than 90 days following completion of each event's SFV measurements. The final reports must include all details prescribed above for the interim report as well as, at minimum, the following: the peak sound pressure level (SPL_{pk}), the root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), the

single strike sound exposure level (SEL_{ss}), the integration time for SPL_{rms}, the spectrum, and the 24-hour cumulative SEL extrapolated from measurements at all hydrophones. The final report must also include at least the maximum, mean, minimum, median (L_{50}) and L_5 (95 percent exceedance) statistics for each metric; the SEL and SPL power spectral density and/or one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported; the sound levels reported must be in median, arithmetic mean, and L_5 (95 percent exceedance) (*i.e.*, average in linear space), and in dB; range of TL coefficients; the local environmental conditions, such as wind speed, transmission loss data collected on-site (or the sound velocity profile); baseline pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern); a description of depth and sediment type, as documented in the Construction and Operation Plan (COP), at the recording and foundation installation locations; the extents of the measured Level A harassment and Level B harassment zone(s); hammer energies required for pile installation and the number of strikes per pile; the hydrophone equipment and methods (*i.e.*, recording device, bandwidth/sampling rate; distance from the pile where recordings were made; the depth of recording device(s)); a description of the SFV measurement hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information; the spatial configuration of the noise attenuation device(s) relative to the pile; a description of the noise abatement system and operational parameters (*e.g.*, bubble flow rate, distance deployed from the pile, *etc*.), and any action taken to adjust the noise abatement system. A discussion which includes any observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices.

(10) If at any time during the project LOA Holder becomes aware of any issue or issues which may (to any reasonable subject-matter expert, including the persons performing the measurements and analysis) call into question the validity of any measured Level A harassment or Level B harassment isopleths to a significant degree, which were previously transmitted or communicated to NMFS Office of Protected Resources, LOA Holder must inform NMFS Office of Protected Resources within 1 business day of becoming aware of this issue or before the next pile is driven, whichever comes first.

(11) If a North Atlantic right whale is acoustic detected at any time by a project-related PAM system, LOA Holder must ensure the detection is reported as soon as possible to NMFS, but no longer than 24 hours after the detection via the *24-hour North Atlantic right whale Detection Template* (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*). Calling the hotline is not necessary when reporting PAM detections via the template;

(12) Full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction must be submitted within 90 calendar days after the conclusion of activities requiring PAM for mitigation. Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at *https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*. The full acoustic recordings from all real-time hydrophones must also be sent to the National Centers for Environmental Information (NCEI) for archiving within 90 calendar days after pile driving has ended and instruments have been pulled from the water.

(13) LOA Holder must submit situational reports if the following circumstances occur (including all instances wherein an exemption is taken must be reported to NMFS Office of Protected Resources within 24 hours):

(i) If a North Atlantic right whale is observed at any time by PSOs or project personnel, LOA Holder must ensure the sighting is immediately (if not feasible, as soon as possible and no longer than 24 hours after the sighting) reported to NMFS and the Right Whale Sightings Advisory System (RWSAS). If in the Northeast Region (Maine to Virginia/North Carolina border) call (866-755-6622). If in the Southeast Region (North Carolina to Florida) call (877-WHALE-HELP or 877-942-5343). If calling NMFS is not possible, reports can also be made to the U.S. Coast Guard via channel 16 or through the WhaleAlert app (*http://www.whalealert.org/*). The sighting report must include the time, date, and location of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), Lease Area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information.

(ii) If a North Atlantic right whale is observed at any time by PSOs or project personnel, LOA Holder must submit a summary report to NMFS Greater Atlantic Regional Fisheries (GARFO; *nmfs.gar.incidental-take@noaa.gov*) and NMFS Office of Protected Resources, and NMFS Northeast Fisheries Science Center (NEFSC; *ne.rw.survey@noaa.gov*) within 24 hours with the above information and the vessel/platform from which the sighting was made, activity the vessel/platform was engaged in at time of sighting, project construction and/or survey activity at the time of the sighting (*e.g.*, pile driving, cable installation, HRG survey), distance from vessel/platform to sighting at time of detection, and any mitigation actions taken in response to the sighting.

(iii) If an observation of a large whale occurs during vessel transit, LOA Holder must report the time, date, and location of the sighting; the vessel's activity, heading, and speed (knots); Beaufort sea state, water depth (meters), and visibility conditions; marine mammal species identification to the best of the observer's ability and any distinguishing characteristics; initial distance and bearing to marine mammal from vessel and closest point of approach; and any avoidance measures taken in response to the marine mammal sighting.

(iv) In the event that personnel involved in the Project discover a stranded, entangled, injured, or dead marine mammal, LOA Holder must immediately report the observation to NMFS. If in the Greater Atlantic Region (Maine to Virginia) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622); if in the Southeast Region (North Carolina to Florida), call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, LOA Holder must report the incident to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov)* and, if in the Greater Atlantic region (Maine to Virginia), NMFS Greater Atlantic Regional Fisheries Office (GARFO; *nmfs.gar.incidental-take@noaa.gov*, *nmfs.gar.stranding@noaa.gov*) or, if in the Southeast region (North Carolina to Florida), NMFS Southeast Regional Office (SERO; *secmammalreports@noaa.gov*) as soon as feasible. The report (via phone or email) must include contact (name, phone number, *etc.*), the time, date, and location of the first discovery (and updated location information if known and applicable); species identification (if known) or description of the animal(s) involved; condition of the animal(s) (including carcass condition if the animal is dead); observed behaviors of the animal(s), if alive; if available, photographs or video footage of the animal(s); and general circumstances under which the animal was discovered.

(v) In the event of a vessel strike of a marine mammal by any vessel associated with the Project or if other project activities cause a non-auditory injury or death of a marine mammal, LOA Holder must immediately report the incident to NMFS. If in the Greater Atlantic Region (Maine to Virginia) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (North Carolina to Florida) call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, LOA Holder must immediately report the incident to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov)* and, if in the Greater Atlantic region (Maine to Virginia), NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov, nmfs.gar.stranding@noaa.gov*) or, if in the Southeast region (North Carolina to Florida), NMFS SERO (*secmammalreports@noaa.gov*). The report must include the time, date, and location of the incident; species identification (if known) or description of the animal(s) involved; vessel size and motor configuration (inboard, outboard, jet propulsion); vessel's speed leading up to and during the incident; vessel's course/heading and what operations were being conducted (if applicable); status of all sound sources in use; description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; estimated size and length of animal that was struck; description of the behavior of the marine mammal immediately preceding and following the strike; if available, description of the presence and behavior of any other marine mammals immediately preceding the strike; estimated fate of the animal (*e.g.*, dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and to the extent practicable, photographs or video footage of the animal(s). LOA Holder must immediately cease all on-water activities until the NMFS Office of Protected Resources is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOAs. NMFS Office of Protected Resources may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. LOA Holder may not resume their activities until notified by NMFS Office of Protected Resources.

(14) LOA Holder must report any lost gear associated with the fishery surveys to the NOAA GARFO Protected Resources Division (*nmfs.gar.incidental-take@noaa.gov*) as soon as possible or within 24 hours of the documented time of missing or lost gear. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear.

APPENDIX C