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 New England Wind Offshore Energy Project (Lease OCS-A 0534) GARFO-2022-03608
CONDUCTED BY:	National Marine Fisheries Service Greater Atlantic Regional Fisheries Office
DATE ISSUED:	February 16, 2024
APPROVED BY:	____________________________ Michael Pentony Regional Administrator

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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 approval, with conditions, of the Construction and Operation Plan (COP) authorizing the construction, operation, maintenance, and decommissioning of the New England Wind Offshore Wind Project under the Outer Continental Shelf Lands Act (OCSLA). The applicant and lessee, Park City Wind, LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, is proposing to construct, operate, and eventually decommission a commercial-scale offshore wind energy facility within Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 across two phases. Phase 1, termed Park City Wind, would consist of between 41-62 wind turbine generators, one to two electrical service platforms, and associated inter-array cabling as well as export cabling to bring electricity to land. Phase 2, known as Commonwealth Wind, would consist of up to 88 wind turbine generators, up to three electrical service platforms, and associated inter-array cabling as well as export cabling to bring electricity to land. Across the two phases, a total of up to 132 foundations will be installed.

BOEM is the lead federal agency for purposes of section 7 consultation; the other action agencies include 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 (OCSLA). 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). Park City filed their COP with BOEM on July 2, 2020, with subsequent updates in October 2021 and June 2022[2]. BOEM issued a Notice of Intent to prepare an Environmental Impact Statement (EIS)

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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 June 2022 COP and appendices are available online at: https://www.boem.gov/renewable-energy/state-activities/new-england-wind-ocs-0534-construction-and-operations-plan
Last accessed August 14, 2023.

under the National Environmental Policy Act (NEPA) (42 USC § 4321 et seq.) on June 30, 2021, to assess the potential biological and physical environmental impacts of the Proposed Action and Alternatives (86 FR 34782) on the human environment. A draft EIS (DEIS) was published on December 23, 2022.[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 is proposing to issue OCS Air Permits to Park City Wind, LLC for the New England Wind 1 and New England Wind 2 projects. The EPA is proposing to issue the OCS air permits pursuant to section 328 of the CAA and applicable rules and regulations promulgated under 40 C.F.R. part 55. On January 13, 2023, EPA received revised OCS air permit applications, which replaced the initial applications. EPA determined the applications to be administratively complete on February 13, 2023. EPA's permits will contain the applicable requirements under 40 C.F.R. part 55; the draft permits were published for public comment on December 19, 2023[4]. The draft permits include 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 permits are included as an element of the proposed action in this opinion.

USACE issued two Public Notices (NAE-2021-01301 for Phase 1 and NAE-2022-01890 for Phase 2[5]) describing its consideration of Park City Wind's request for permit authorizations 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 December 22, 2022. In the notices, USACE notes that work regulated and proposed for authorization by USACE, through section 10 of the Rivers and Harbors Act of 1899 and section 404 of the Clean Water Act, involves the construction, operations and maintenance, and eventual decommissioning of two wind farms known as Park City Wind and Commonwealth Wind with the associated New England Wind Export Cable. Across both phases, New England Wind would include the installation of up to 132 foundations for wind turbine generators and electrical service platforms and associated inter-array and

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[3] The DEIS is available online at: https://www.boem.gov/renewable-energy/state-activities/new-england-wind-draft-environmental-impact-statement-deis
Last accessed August 14, 2023.

[4] Proposed Permits and Public Notices available at: https://www.epa.gov/caa-permitting/permit-documents-new-england-wind-1-wind-energy-development-project and https://www.epa.gov/caa-permitting/permit-documents-new-england-wind-2-wind-energy-development-project

[5] Public Notices are online at https://www.nae.usace.army.mil/Portals/74/docs/regulatory/PublicNotices/2022/NAE-2021-01301PublicNoticePhase1.pdf and https://www.nae.usace.army.mil/Portals/74/docs/regulatory/PublicNotices/2022/NAE-2022-01890-PublicNoticePhase2.pdf
Last accessed August 14, 2023.

exporting cabling. USACE's permit authorizations are included as an element of the proposed action 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 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, ESPs, 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 Park City Wind, LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, for the incidental take of small numbers of marine mammals during the construction of the New England Wind Offshore Wind Farm project.[6] The requested ITR would govern the authorization of take, by both Level A and Level B harassment[7], of "small numbers" of marine mammals over a 5-year period incidental to construction-related foundation installation activities (drilling and impact and vibratory pile driving), detonation of unexploded ordnances or munitions and explosives of concern, and high-resolution geophysical (HRG) site characterization surveys conducted by Park City in Federal and State waters off of Massachusetts. A final ITR would allow for the issuance

[6] Application, Notice of Receipt of Application, Proposed Rule, and Supporting Materials are available online at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-park-city-wind-llc-construction-new-england-wind-offshore-wind; Last accessed September 28, 2023.

[7] 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.

of a LOA to Park City for a 5-year period. NMFS OPR's issuance of an ITR and LOA is included as an element of the proposed action in this opinion.

Park City may choose to obtain a Letter of Acknowledgment from NMFS for certain fisheries survey activities. A Letter of Acknowledgement acknowledges, but does not authorize, 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 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 action we are consulting on includes surveys following issuance of this opinion that are mandated in connection with approval of the New England Wind project that may be carried out with a Magnuson-Stevens Act Letter of Acknowledgement. These surveys and their effects would not occur but for the New England Wind project proposed in the COP 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) on September 7, 2022 with a request for consultation as the lead federal agency for the ESA consultation and on behalf of BSEE, USACE, EPA, and the USCG; this BA and request for consultation also acknowledged NMFS OPR's anticipated issuance of a proposed MMPA ITA. We requested additional information from BOEM on November 7, 2022. BOEM submitted a revised BA on March 10, 2023; we requested additional information on April 13, 2023. BOEM submitted the final BA on May 8, 2023. On May 25, 2023, we notified BOEM of information that was missing from the BA that was necessary to initiate consultation. We received that information on June 15, 2023.

On May 9, 2023, we received a draft *Notice of Proposed Incidental Take Regulation for the Taking of Marine Mammals Incidental to the New England Wind Project Offshore Massachusetts*, from the NMFS Office of Protected Resources (OPR) and an accompanying request for ESA section 7 consultation; the proposed rule published in the FR on June 8, 2023 (88 FR 37606).

On June 15, 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)); formal ESA 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. On August 29, 2023, NMFS was notified that the applicant intended to redo much of their acoustic modeling for foundation installation which was expected to result in revisions to their request for take included in their MMPA application as well as potential changes to their estimates of the amount and extent of exposure of ESA listed sea turtles and Atlantic sturgeon to project noise. As this had direct bearing on the consideration of effects of the proposed action on ESA listed species, NMFS and BOEM agreed to a delay in the ESA consultation timeline to accommodate the applicant's submission of this new information. A new completion date for the consultation and issuance of a biological opinion of February 16, 2024 was agreed to by NMFS, BOEM, and Park City, as well as the other action agencies. The final documents for the updated modeling were received on December 5, 2023, and after review were deemed complete by BOEM and the Office of Protected Resources on December 18, 2023. An updated version of the BA was issued by BOEM on December 18, 2023, and the Office of Protected Resources provided us with new clearance zones and take estimates for ESA listed marine mammal species on December 19, 2023. Refinements of these take estimates were provided through February 2, 2024.

Consideration of Activities Addressed in Other ESA Section 7 Consultations

As described in section 3 below, some New England Wind project vessels will utilize the Paulsboro Marine Terminal in Paulsboro, NJ. NMFS GARFO has completed ESA section 7 consultation with the USACE for the construction and use of the Paulsboro Marine Terminal. The Biological Opinion prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023[8], "2023 Paulsboro Opinion") considered effects of all vessels transiting between the mouth of Delaware Bay and the port on ESA listed species in the Delaware River and Delaware Bay and critical habitat designated for the New York Bight distinct population segment (DPS) of Atlantic sturgeon.

The Paulsboro Opinion analyzed an overall amount of vessel transits anticipated over a 10-year period, of which New England Wind would contribute a small part. The effects analyzed in the completed Paulsboro Opinion will be considered as part of the *Environmental Baseline* of this

[8] 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.

Opinion, given the definition of that term at 50 CFR §402.02. The effects specific to the New England Wind project's vessel use of the Paulsboro Marine Terminal will be discussed in the *Effects of the Action* section by referencing the analysis in the Paulsboro Opinion and determining whether the effects of the New England Wind project's vessels transiting to and from the port are consistent with the analysis in the Paulsboro Opinion or anticipated to cause additional or different effects. In the *Integration and Synthesis* section, if we determine any additional or different effects of the New England Wind project 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 Paulsboro Biological Opinion. By using this methodology, this Opinion ensures that all of the effects of New England Wind vessel transits to and from the Paulsboro facility 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 New England Wind vessel transits to and from the port–once in the *Environmental Baseline* and then again in the *Effects of the Action* section. Any incidental take anticipated by New England Wind vessel transits, even if already specified and exempted in the Paulsboro Opinion's Incidental Take Statement (ITS), will also be specified in this Opinion's ITS and will be subject to the relevant reasonable and prudent measures and implementing terms and conditions from the Paulsboro Opinion. This approach is being taken because BOEM was not a party to the Paulsboro Opinion, yet New England Wind vessel transits to/from the Paulsboro Marine Terminal 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 ITS that will apply to the relevant action agencies identified in this Opinion and its ITS.

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 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 for reference. For clarity, we define those terms here. The Wind Development Area (WDA) is the area consisting of the location of the wind turbine generators, offshore substations, inter-array cables (IAC), and the cable corridors between the electrical service platforms (ESP) and the landfall sites in Massachusetts. The Wind Farm Area (WFA) is a subset of the WDA and is that portion of the New England Wind lease area (OCS-A 0534) and a portion of OCS-A 0501 where the wind turbine generators and ESPs will be installed and operated (i.e., the offshore portion of the WDA minus the cable routes to shore); in this case, the New England Wind WFA and lease area OCS-A 0534 are nearly co-extensive and we may use these terms interchangeably in this Opinion. The action area is defined in section 3.9 below and includes the WDA (and WFA which is nearly coextensive with the lease area) as well as the portion of the U.S. EEZ used by project vessels transiting from ports along the U.S. Atlantic Coast (inclusive of identified ports in the Delaware and Hudson rivers) and the portion of the U.S. EEZ used by project vessels transiting from ports in Canada and Europe.

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 the two phased New England Wind Farm (NEWF) located in Lease Area OCS-A 0534 and a portion of lease area OCS-A 0501. The Lease Area is located on the outer continental shelf (OCS), with the closest edge of the Lease Area approximately 23 miles (37 kilometers [km]) south of Martha's Vineyard and approximately 43 miles (69.2 kilometers [km]) southeast of mainland Rhode Island. The proposed location of the NEWF and the NEWEC installation corridor are shown in Figure 3.1.

In addition to BOEM's proposed approval of Park City's Construction and Operations Plan (COP) for the New England Wind Project, BOEM's September 7, 2022, request for consultation also addressed: EPA's proposal to issue two Outer Continental Shelf Air Permits; the USACE's proposal to issue two permit decisions 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's proposal to issue a Private Aids to Navigation (PATON) Authorization(s). In their request for consultation, 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). NMFS OPR submitted a separate request for consultation on May 9, 2023 which was supplemented by additional information provided on December 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. 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 (NPDES) Vessel General Permit standards.

The information presented here reflects the proposed action described by BOEM in their May 8, 2023, Biological Assessment, the Addendums received on June 6, 2023, and June 15, 2023, the updated Biological Assessment received on December, 18, 2023 and the proposed Marine Mammal Protection Act Incidental Take Authorization (88 *Federal Register* 37606; June 8, 2023) as well as the supplemental information provided by OPR, including updates to the amount and type of take proposed for authorization under the MMPA and updated clearance zones received on December, 19, 2023 as well as corrections and refinements of this information received into February 2024. Here, for simplicity, we may refer to BOEM's proposed action when that proposed action may also include other federal actions (e.g., construction of the wind turbines requires authorizations from BOEM, USACE, EPA, USCG, and NMFS OPR).

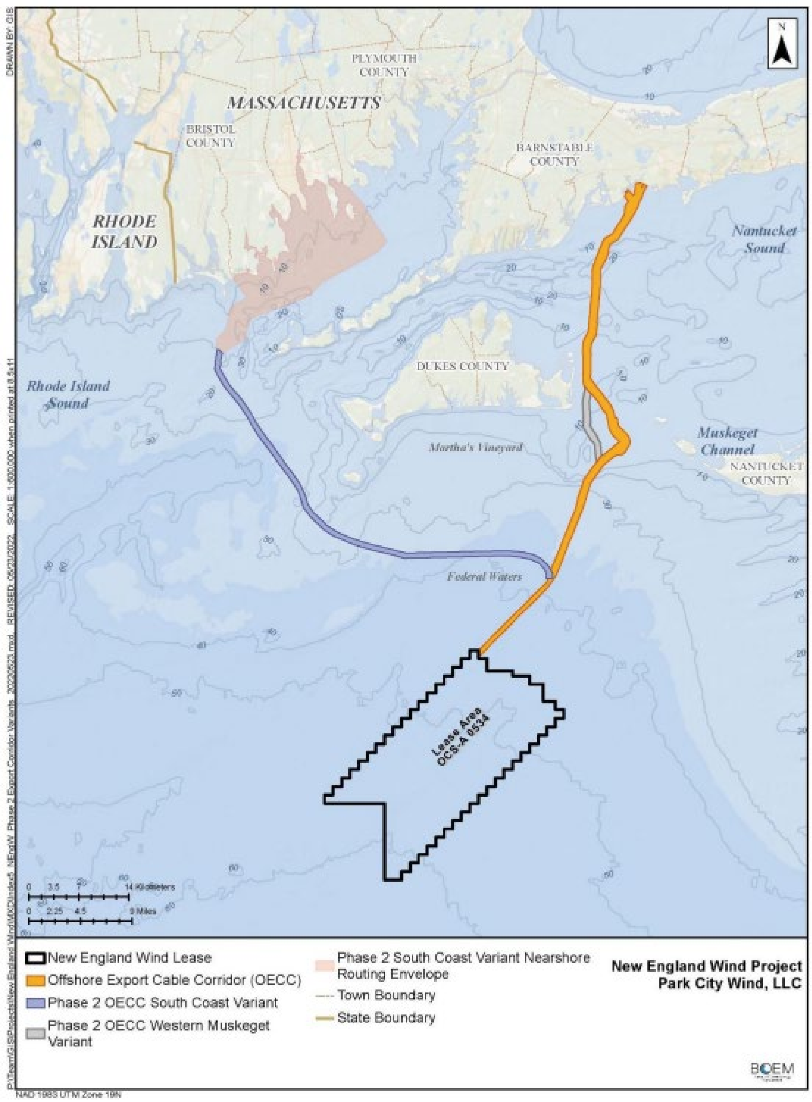
The proposed action described in the BA and analyzed in this Opinion consists of New England Wind Phase 1 (Park City) and New England Wind Phase 2 (Commonwealth) which together are the New England Wind Project. The projects will be developed to support future power purchase agreements with one or more states in the Northeast U.S. The New England Wind project as whole includes a maximum of 130 positions for wind turbine generators (WTG) or electrical service platforms (ESP), consisting of 2 to 5 ESPs and up to 129 WTGs, (all but one of the ESPs could be integrated onto WTG foundations), with a maximum of 132 foundations if co-located ESPs are used (with two foundations at one position). For Phase 1, between 41 and 62 WTGs would be constructed with one or two electric service platforms (ESP); all foundations would be monopiles or piled jackets. Strings of WTGs will connect with the ESP(s) via a submarine inter-array cable transmission system. Two high-voltage alternating current (HVAC) offshore export cables, up to 101 km (62.8 mi) in length per cable, would be installed; the offshore export cable(s) would transmit electricity from the ESP(s) to a landfall site. The design of Phase 2 depends in part on the final footprint of Phase 1. Phase 2 is expected to consist of 64-88 WTGs (on monopiles, jackets (with piles or suction buckets), or bottom-frame foundations (with piles or suction buckets)) and 1 to 3 ESPs (monopile or jacket foundation (with piles or suction buckets)). Inter-array cables will transmit electricity from the WTGs to the ESP(s). Two or three HVAC offshore export cables, each with a maximum length of 116–124 km (63–67 NM) per cable, will transmit power from the ESP(s) to shore.

Foundations will be installed in Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 in the event that Vineyard Wind 1 does not develop "spare" or extra positions included in Lease Area OCS-A 0501 and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. As explained above, the New England Wind WDA (referred to as the Southern Wind Development Area (SWDA) in the COP) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, as shown in Figure 1.1-1 of COP Volume I (Figure 3.2 below).

Five HVAC offshore export electric cables (two for Phase 1 and three for Phase 2) will transmit electricity from the Projects to shore. As described in the COP, unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared Offshore Export Cable Corridor (OECC) that will travel from the northwestern corner of the WDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable, Massachusetts. The cables will be buried to a target depth of 5 to 8 feet (1.5 to 2 m) below the seafloor. Alternative cable routes identified for Phase 2 are the Muskeget Variant and the South Coast Variant.

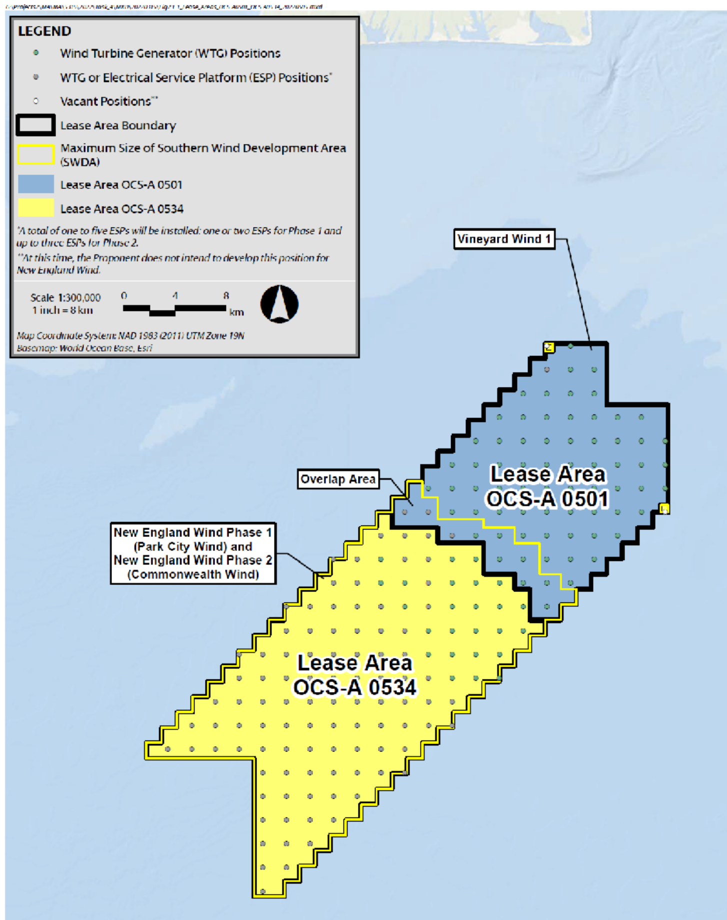
The project also includes a number of survey components including high-resolution geophysical surveys (HRG), and a Fisheries Research and Monitoring Plan that includes biological monitoring surveys, acoustic telemetry, and benthic monitoring. These survey activities will occur during the pre-construction, construction, and operation and maintenance phases of the project.

Figure 3.1 NEWF and NEWEC Location



(source: Figure 1-2 in BOEM's BA)

Figure 3.2 New England Wind Foundation Locations



(source: COP Figure 2.1-1)

3.2 Construction

Offshore construction includes installation of WTGs, ESPs, and installation of inter-array, interlink, and export cables. Prior to installation of foundations and cables, site preparation activities will take place. These include clearance of unexploded ordnance/munitions and explosives of concern (UXO/MEC or generally, UXO) and seafloor preparation (boulder clearing, dredging, and pre-lay grapnel runs). The total number of construction and installation days for each project component would depend on several factors, including environmental conditions, planning, construction, and installation logistics. At the time consultation was initiated, onshore construction was anticipated to begin as early as late 2023; the construction schedules included in the BA reflect that timeline. An updated construction schedule, considering a 2025 start, was included in the proposed MMPA ITA. That schedule is presented below (Table 3.1). While there may be additional shifts in the years that construction will occur, the order and duration of the various activities presented in the table below remain accurate.

Table 3.1. New England Wind Project Estimated Activity Schedule

Project Activity		
HRG Surveys	Q1 2025- Q4 2029	Any time of the year, up to 25 days per year
Scour Protection Pre- or Post-Installation	Q1 2025- Q4 2029	Any time of the year
WTG and ESP Foundation Installation, Schedule A	Q2-Q4 2026 and 2027[1]	Up to 8 months per year
WTG and ESP Foundation Installation, Schedule B	Q2-Q4 2026, 2027, and 2028[1]	Up to 8 months per year
Horizontal Directional Drilling at Cable Landfall Sites	Q4 2025- Q2 2026	Up to 150 days
UXO/MEC Detonations	Q2-Q4 2025 and 2026[3]	Up to 6 days in 2025 and 4 days in 2026. No more than 10 days total, limited to May – December.
Inter-array Cable Installation	Q3-Q4 2026 and Q2 2027–Q2 2028	Phase 1: 5 months[2] Phase 2: 10 months[2]
Export Cable Installation and Termination	Q2 2026-Q2 2028	Phase 1: 8-9 months[1] Phase 2: 13-17 months[1]
Fishery Monitoring Surveys	Q1 2025- Q4 2029	Any time of year
Turbine Operation	Initial turbines operational 2027, all turbines operational by 2028	

[1-] Foundation installation pile driving would be limited to May-December, annually.
[2-] The Project is divided into two phases: Park City Wind (Phase 1) and Commonwealth Wind (Phase 2).
source: Table 1, 88 FR 37606

3.2.1 UXO/MEC Clearance/Detonation and Sea Floor Preparations

As described in the BA, BOEM and Park City have determined that UXO/MEC may be present in the lease area and NEWEC corridor. Park City will adhere to the as low as reasonably practicable (ALARP) standard process with avoidance of UXOs as the preferred mitigation methodology. As described in the BA, the exact number, size, and location of UXOs present in the Lease Area and NEWEC corridor are not currently known. The proposed "lift and shift" operations would relocate MEC/UXO to an adjacent location or previously designated disposal areas for either wet storage or disposal through low- or high-order methods. If avoidance or "lift and shift" are not possible, other methods will be considered including cutting the UXO/MEC open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO/MEC (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would a decision to detonate the UXO/MEC in place be made. To detonate a UXO/MEC, a small charge would be placed on the UXO/MEC and detonated causing the UXO/MEC to then detonate.

As described in the BA, Park City has estimated that up to 10 devices of up to 454-kg (1,000 lbs) may be encountered across both phases of project construction that would require high-order detonation in place. BOEM considers that due to the substantial pre-construction surveys that have been and will continue to be undertaken to locate and remedy confirmed MEC/UXO, the likelihood of an unanticipated MEC/UXO encounter is very low. In-situ detonation activities would be limited to one detonation per day. Implementation of sound attenuation technologies capable of achieving a 10-dB reduction in source sound intensity would be required by BOEM for all detonations. Conditions of the MMPA ITA would limit detonations to daylight hours only from May 1 through December 31.

In the BA, BOEM has not identified any other seafloor preparation activities proposed to facilitate installation of WTG or ESP foundations. Activities proposed to facilitate installation of cables (e.g., boulder removal, dredging the top of sand waves, pre-lay grapnel runs) is described in the cable installation section below.

3.2.2 Foundation Installation – WTGs and ESPs

Foundations will be installed following completion of any UXO/MEC removal. The applicant is proposing to install 41 to 62 WTGs and 1 or 2 ESPs in Phase 1 and 64 to 88 WTGs and up to 3 ESPs in Phase 2 (see Tables S-1 and S-2 in the COP for more details). The WTGs would be installed in a uniform east-to-west, north-to-south grid pattern with 1-nautical-mile (1.9-kilometer, 1.15-mile) × 1-nautical-mile (1.9-kilometer, 1.15-mile) spacing between positions. Some ESPs would be collocated, resulting in a total of 132 foundations. Specifications of the WTGs and ESPs and their foundations are described in the BA (Table 1-2 and Table 1-7). No foundation installation (vibratory or impact pile driving with relief drilling) would occur from January 1-April 30 of any year. Foundation installation is expected to occur over two to three construction seasons.

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. 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. Park City 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.

Phase 1 WTGs would be mounted on either 12-meter monopiles or jacket foundations (4 pin piles with up to 4 m diameter), and Phase 2 WTGs would be mounted on either 12- or 13-meter monopiles, 4-meter jacket, or 4-meter bottom-frame foundations. The ESPs proposed for both Phase 1 and Phase 2 would be installed on jacket foundations.

A bottom-frame foundation, currently only being considered for Phase 2, is a triangular space frame with a vertical column supporting the WTG connected to three legs that radiate outward toward the feet of the foundation (Figure 1-13 in BOEM's BA). The feet of the bottom-frame foundation may be secured either using driven pin piles or suction buckets, which would be pushed up to 49 feet (15 meters) into the seabed by pumping water out of the bucket.

The WTG, ESPs, and their foundations would be installed using jack-up vessels, anchored vessels, or dynamic positioning (DP) vessels, along with necessary support vessels and supply vessels. If suction bucket piles are used in Phase 2, they would be installed using suction pumps attached to the buckets, which would pump water and air out of the space between the suction buckets and seafloor, pushing the buckets down into the seafloor. Once full penetration is achieved, the suction pumps would be recovered to the vessel. Any remaining interstitial space between the bucket and seafloor may be filled with grout, sand, or concrete (see COP Volume I, Section 4.3.1.4.3; Epsilon 2022).

It is estimated that a total of up to 55 acres (0.22 km^2) of seafloor would be temporarily disturbed during installation of the foundations during Phase 1 and up to 74 acres (0.30 km^2) would be temporarily disturbed during installation of the WTG topside during Phase 1 (COP Appendix III-T; Epsilon 2022). The temporary footprint of seafloor disturbance during installation of the foundations and WTG topside during Phase 2 was estimated to be 68 acres (0.28 km^2) and 91 acres (0.37 km^2), respectively (COP Appendix III-T; Epsilon 2022).

As described in JASCO 2023, all monopile, jacket, and piled bottom-frame foundations would be installed using impact pile driving. 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 6,000 kilojoules and would drive the monopiles up to 40m into the seabed. Up to two monopiles could be installed per day. When accounting for pre-piling preparatory work and post-piling activities, installation of a single monopile or jacket pile will take approximately 6–13 hours. Park City anticipates at least 1 hour between monopile installations and 30 minutes between jacket pin pile installations. The impact hammer utilized for installation of pin piles for piled jacket foundations would have a maximum rated capacity of 3,500 kilojoules and would drive the pin piles up to 50m into the seabed. Four pin piles would be driven per day.

For some piles, vibratory pile setting will be used before impact pile driving begins to mitigate the risk of pile run, an effect where due to unstable soil conditions, the pile begins to move under its own self weight through the soil in an uncontrolled manner (JASCO 2022). The vibratory hammer mitigates this risk by forming a hard connection to the pile using hydraulic clamps, thereby acting as a lifting/handling tool, as well as a vibratory hammer. The tool is inserted into the pile on the construction vessel deck, and the connection is made. The pile is then lifted, upended, and lowered into position on the seabed using the vessel crane. After the pile is lowered into position, vibratory pile installation would commence. Vibratory pile installation is a technique where piles are driven into soil using a longitudinal vibration motion. The motion is produced by a vibratory hammer, which contains a system of rotating eccentric weights, powered by electric or hydraulic motors. The vibratory effect begins to push the pile through the soil strata by unsettling the soil locally surrounding the pile. The pile would be kept vertical through the vibratory installation, as it is still connected to the vessel crane. The crane would continue to slowly lower the pile, and once a certain depth of penetration has been achieved (the penetration depth will be pre-determined using pile drivability engineering studies to ascertain the pile stability in the soil without exposure to pile run risk), the vibratory motion would be stopped from the control cabin on the construction vessel, and the hard clamped connection between the vibratory hammer and the pile would be released. The vibratory hammer is then recovered to the vessel. At this point, the pile would be self-stable and standing vertically in the soil without any connection or support from the vessel crane and safe to lift the impact hammer onto the pile, and commence impact hammer driving. The use of vibratory hammering would decrease the amount of impact hammering required (JASCO 2022). Based on a seabed drivability analysis conducted by the applicant, approximately 50 percent of the foundations may require vibratory pile driving, resulting in a total of 70 foundations that may require vibratory pile driving (JASCO 2023).

Drilling may be required in the event of pile refusal. A pile refusal can occur if the total frictional resistance of the soil becomes too much for the structural integrity of the pile and the capability of the impact hammer. Continuing to drive in a refused condition can lead to overstress in the pile and could potentially buckle (tear) the pile material. The use of an offshore drill can reduce the frictional resistance by removing the material from inside the pile and allowing the continuation of safe pile driving. An offshore drill is an equipment piece consisting of a motor and bottom hole assembly. The drill is placed on top of the refused pile using the construction vessel crane, and the bottom hole assembly is lowered down to the soil inside the pile. On the bottom face of the bottom hole, assembly is a traditional “drill bit,” which slowly rotates (at 4 or 5 revolutions per minute or approximately 1.3 feet [0.4 meters] per hour) and begins to disturb the material inside the pile. As the disturbed material mixes with seawater, which is pumped into the pile, it begins to liquefy. The liquefied material is pumped out to a pre-designated location, leaving only muddy seawater inside the pile instead of a solid “soil plug” and largely reducing the frictional resistance generated by the material inside the pile. When enough material has been removed from inside the pile and the resistance has reduced sufficiently, the drill is then lifted off the pile and recovered to the vessel. The impact hammer is then docked onto the pile and impact pile driving commences (JASCO 2022). Based on the seabed drivability analysis conducted by the applicant, a total of 48 foundations may require drilling (JASCO 2023).

The Proposed Action includes two potential construction schedules, which incorporate the maximum PDE and allows for some flexibility in the final construction plan. The first construction schedule (Construction Schedule A) assumes a 2-year construction scenario where 54 Phase 1 WTGs are installed on monopiles, 53 Phase 2 WTGs are installed on monopiles, 23

Phase 2 WTGs are installed on jackets, and 2 ESPs are installed on jackets (one during each phase). Construction Schedule A assumes that foundations for all of Phase 1 and a portion of Phase 2 are installed in Year 1 and that the remaining Phase 2 foundations are installed in Year 2. Construction Schedule B assumes a 3-year construction scenario where 55 Phase 1 WTGs are installed on monopiles, 75 Phase 2 WTGs are installed on jackets, and 2 ESPs are installed on jackets (one during each phase). Construction Schedule B assumes that all ESP foundations and Phase 1 monopile WTG foundations are installed in Year 1 and that the Phase 2 jacket WTG foundations are installed in Years 2 and 3. However, under both construction schedules two positions may potentially have co-located ESPs (i.e., two foundations installed at one grid position), resulting in 132 foundations, so though the table below (Table 3.2, Table 1-3 in the MMPA ITA) includes 133 foundations installed in this schedule, only 132 would be installed under the Proposed Action (JASCO 2023).

Construction Schedule B has the longest duration (3 years) and the greatest number of piling days. Therefore, in BOEM's BA and in the Proposed MMPA ITA, Construction Schedule B is carried forward to consider the effects of the action. A summary of the number of piling days under Construction Schedule B is provided in Table 3.2 below (Table 1-3 in the BA). No pile driving for foundation installation will occur between January 1 and April 30 in any schedule.

Table 3.2. Maximum Monthly Pile Driving Days, Construction Schedule B (All Years Summed)[a]

Month	Total Days of Impact Pile Driving	Total Days with Vibratory Setting Followed by Impact Pile Driving[b]	Total Days with Drilling[c]	Total Days of Foundation Installation
May	6	0	4	6
June	17	6	10	23
July	15	11	9	26
August	10	16	9	26
September	7	10	9	17
October	0	8	4	8
November	2	3	3	5
December	2	0	0	2
Total	59	54	48	113
Total days	113 days			
Total foundations	133 foundations			
Total piles	367 piles			

Source: JASCO 2023
dB = decibel; SPL = root-mean-square sound pressure level
[a] This schedule covers the 5-year construction period 2025–2029, during which pile installation is scheduled to begin in 2026. These dates reflect the currently projected construction start year and are subject to change because exact project start dates and construction schedules are not currently available. No concurrent/simultaneous pile driving of foundations is planned.
[b] The number of days with vibratory pile setting is based on a percentage of the number of days of pile installation and includes installation of a mix of monopiles at a rate of both 1 per day and 2 per day as well as installation of jacket foundations at a rate of four pin piles per day.

[c] For acoustic modeling, it was assumed that vibratory pile setting and drilling would not occur on the same day. However, for months when the number of days with vibratory pile setting plus the number of days with drilling exceeded the total number of impact piling days that month, the minimum number of days of overlap possible were assumed for these two activities.

During the installation of foundations, Park City is proposing a 24-hour work window. Both the BA and proposed MMPA ITA describe the conditions that Park City 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 and the BA, 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 started during daylight hours and it is necessary to continue piling during the night to protect the integrity of the foundation started during the day or necessary for human life or safety. Park City has indicated that leaving jacket foundations partially installed is expected to be unsafe. 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.

Electric Service Platforms
As described in the BA, Phase 1 would include one or two ESPs, while Phase 2 would include up to three ESPs. Both Phase 1 and Phase 2 ESPs would be installed on a monopile or jacket foundations with pin piles, as described above. The ESPs would serve as the interconnection point between the WTGs and the export cable and include step-up transformers and other electrical equipment needed to connect inter-array cables for each phase to the corresponding offshore export cables. Depending on the size of WTGs installed for Phase 2, the transformer and other electrical equipment necessary to connect inter-array cables to export cables could be installed on WTG platforms, rather than a dedicated ESP platform. Installation of the ESP topside and foundations would result in a total estimated temporary disturbance footprint of 5 acres (0.02 km^2) during Phase 1 and 7 acres (0.03 km^2) during Phase 2 for all proposed ESPs (COP Appendix III-T; Epsilon 2022). The permanent footprint of all the proposed ESP foundations with scour protection during both Phase 1 and Phase 2 is 17.3 acres (0.07 km^2) (COP Volume III, Section 6.5.2.1; Appendix III-T; Epsilon 2022). Each ESP would contain up to 189,149 gallons (716,007 liters) of oils, lubricants, coolants, and diesel fuel (COP Volume I, Sections 3.3 and 4.3; Epsilon 2022). ESP foundation installations would follow the methods described for the WTG foundations above.

Table 3.3. Electrical Service Platform Specifications

Foundation Type	Monopile	Jacket
Dimensions	197 × 328 × 125 feet (60 × 100 × 38 meters)	197 × 328 × 125 feet (60 × 100 × 38 meters)
Number of piles/foundation	1	3–12
Maximum height[a]	230 feet (70 meters)	230 feet (70 meters)

Source: COP Section 4.2.1.3, Volume I; Epsilon 2022
ESP = electrical service platform; MLLW = mean lower low water
[a] The elevations provided are relative to MLLW, defined as the average of all the lower low water heights of each tidal day observed over the National Tidal Datum Epoch.

Each ESP would require various oils, fuels, and lubricants to support O&M. Sulfur hexafluoride (SF_6) would be used for insulation purposes. Table 3.4 provides a summary of the maximum quantities of these materials anticipated at each ESP. As described in the BA and COP, the spill containment strategy for each ESP consists of preventive, detective, and containment measures. The ESPs will be designed with a minimum of 110 percent of secondary containment of all identified oils, grease, and lubricants. Additionally, ESP devices containing SF_6 will be equipped with integral low-pressure detectors to detect SF_6 gas leakages should they occur.

Table 3.4. Summary of the Maximum Potential Quantities of Oils, Fuels, Lubricants, and SF_6 per ESP in Phase 1.

ESP Equipment	Material	Maximum Quantity per ESP
Transformers and Reactors	Transformer Oil	118,282 gallons (447,744 liters)
Generators	Diesel Fuel	5,468 gallons (20,698 liters)
Medium and High-Voltage Gas-insulated Switchgears	SF_6*	9,083 pounds (4,120 kg)
Crane	Hydraulic Oil	335 gallons (1,267 liters)

* SF_6 (sulfur hexafluoride) gas would be used for electrical insulation in some switchgear components
Source: New England Wind COP (Epsilon 2022).

Table 3.5. Summary of the Maximum Potential Quantities of Oils, Fuels, Lubricants, and SF_6 per ESP in Phase 2.

ESP Equipment	Material	Maximum Quantity per ESP
Transformers and Reactors	Transformer Oil	177,422 gallons (671,616 liters)
Generators	Diesel Fuel	8202 gallons (31,046 liters)
Medium and High-Voltage Gas-insulated Switchgears	SF_6*	13,625 pounds (6,180 kg)
Crane	Hydraulic Oil	335 gallons (1,267 liters)

* SF_6 (sulfur hexafluoride) gas would be used for electrical insulation in some switchgear components
Source: New England Wind COP (Epsilon 2022).

The anticipated construction and installation sequence for the ESP is summarized in Table 3.6. It is anticipated that ESP installation and commissioning may require up to 21 months across both phases, not including cable pull-in.

Table 3.6. Summary of ESP Construction and Installation Sequence.

Activity/Action	Construction and Installation Summary
Foundation Delivery and Installation	Each ESP would be supported by 12-m monopile, 13-m monopile, suction bucket jacket, or 4-m piled jacket foundations. Delivery and installation would be similar to the monopile foundation described above.
Topside Installation	The topside platform, including the transformer module and switchgear, would be assembled as a single unit prior to being transported to the Lease Area via a heavy transport vessel or barge. This expedites the lift of the module onto the foundation. The lift would commence using a suitable installation vessel and the topside platform would be lowered onto the preinstalled foundation. The topside is then secured into position by use of grouted, bolted, or welded connection. This step would occur following installation of the ESP foundation.
Commissioning	Once the ESP topside is secured to the foundation, the NEWEC, ESP-link cable, and IAC would be connected. Communication systems would be set-up with the shore, as well as lighting, firefighting system, etc. Once all systems are enabled, the electrical systems would be commissioned using back-feed (i.e., electricity is fed to the ESP from the onshore grid via the export cables). When completed, the ESP is operational.

Scour Protection for WTG and ESP Foundations
Scour protection would be installed around each foundation to prevent sea floor erosion and scour from natural hydrodynamic processes. Scour protection may be installed before or after the foundations are installed and would consist of placement of a filter layer, rock placement (most common), mattress protection, sandbags, and/or rock bags. Rock placement typically includes a rock armor layer placed over a filter layer with the filter layer installed before or after the foundation. Scour protection would cover approximately 1.1-2.4 acres centered on each WTG and ESP monopile and extend approximately 9.8 feet (3 m) in height above the sea floor. The specific dimensions of scour protection for each foundation type are detailed below in Table 3.7. The total area of scour protection is variable and dependent on the final foundations selected. The quantity of scour protection required would vary based on site conditions and would be determined based on detailed design of the foundation, consideration of geotechnical data, metocean data, water depth, maintenance strategy, agency coordination, stakeholder concerns, and cost.

Table 3.7. Summary of scour protection dimensions for the different foundation types

Maximum Scour Protection per Foundation	Height	Dimensions	Area
Monopile (WTG and ESP)	9.8 feet (3 meters)	Radius 39 meters (128 feet)	1.2 acres (0.0049 km^2)
Piled jacket (WTG)	9.8 feet (3 meters)	Square/rectangle with sides of 68 meters (223 feet)	1.1 acres (0.0045 km^2)
Piled jacket (ESP)	9.8 feet (3 meters)	Rectangle with sides of 129 x 77 meters (423 x 253 feet)	2.5 acres (0.0100 km^2)
Suction bucket jacket (WTG)	9.8 feet (3 meters)	Triangle with sides of 121 meters (397 feet)	1.6 acres (0.0065 km^2)
Suction bucket jacket (ESP)	9.8 feet (3 meters)	Rectangle with sides of 146 meters (479 feet)	5.3 acres (0.0214 km^2)
Piled bottom-frame (WTG)	9.8 feet (3 meters)	Triangle with sides of 126 meters (413 feet)	1.7 acres (0.0069 km^2)
Suction bucket bottom frame (WTG)	9.8 feet (3 meters)	Triangle with sides of 150 meters (492 feet)	2.4 acres (0.0097 km^2)

source: BOEM's BA

3.2.3 Cable Installation

The proposed project includes three cable networks: the IAC, which would carry electrical current produced by the WTGs to the ESPs; an ESP-link cable, that would transfer electrical current between the ESPs; and the NEWEC that would carry electrical current from each ESP to the Onshore Substation. Installation of the three cable networks will require hydraulic plow (i.e., jet-plow and mechanical plow) or similar technology for displacing sediments to allow for cable burial. Park City is proposing to lay most of the inter-array cable and offshore export cable using simultaneous lay and bury via jet embedment. Cable burial would likely use a tool that slides along the seafloor on skids or tracks (up to 3.3 to 10 feet ([1.0 to 3.0 meters wide]), which would not dig into the seafloor but would still cause temporary disturbance.

Phase 1 of the NEWEC would consist of up to two 220-275-kV HVAC submarine cables, each originating at a respective ESP while Phase 2 would involve between two to three 220-345-kV HVAC submarine cables. Within the right-of-way corridor, the seafloor will be disturbed within an approximately 950–1,700 m (3,100–5,500 ft) corridor including the pre-existing Vineyard Wind 1 export cable, inclusive of any boulder clearance. Prior to any sea floor preparation or disturbance required for cable installation, MEC/UXO will be addressed, as described above.

For Phase 1, dredging would occur within a 50-foot (15-m)-wide corridor along submarine cable routes. Park City anticipates that the majority of the dredging corridor would be at the depth of 1.6 feet (.49-m) with some localized areas extending as deep as 17 feet (5.2-m). The target burial depth for the export cable would be 5-8 feet (1.5-2.5 m) for both phases (Epsilon 2022). This dredge corridor includes the up to 1 m (3.3 ft) wide cable installation trench and the up to 3 m (10 ft) wide temporary disturbance zone from the tracks or skids of the cable installation equipment

Dredging is projected to temporarily disturb 52 acres (0.21 km^2) in Phase 1 with 134,800 cubic yards (102,450 cubic meters) of dredged material, while Phase 2 is projected to temporarily disturb 67 acres (0.27 km^2) and could include up to 235,400 cubic yards (179,976 cubic meters) of dredged material. The total area of temporary disturbance due to dredging between both phases is estimated to be up to 548.6 acres (2022 km^2). All dredged material during construction of the Proposed Action would be disposed of within the sand waves in the Project area (Epsilon 2022). Potential dredging option include trailing suction hopper dredge (TSHD) or jetting (also known as mass flow excavation).

A pre-lay grapnel run (PLGR) will be completed to clear cable routes of possible obstructions (e.g., derelict fishing nets, lobster pots, cables, rope, or other debris) prior to installation. Once complete, the sea floor would be prepared for cable installation by removing boulders. Boulder removal would be completed with a boulder grab or boulder plow. For the boulder grab, a grab is lowered to the sea floor, over the targeted boulder and once "grabbed," the boulder is relocated a short distance away. For the boulder plow, boulder clearance is completed by a high-bollard pull vessel, with a towed plow generally forming an extended V-shaped configuration, splaying from the rear of the main chassis. The V-shaped configuration displaces any boulders to the extremities of the plow, thus establishing a clear corridor; multiple passes may be necessary.

The IAC would include multiple segments that extend up to 139 miles (225 kilometers), connecting WTGs to one of the 1-2 ESPs in Phase 1 with an additional 201 miles (325 kilometers) of cable for Phase 2 connecting the additional WTGS to the 1-3 proposed ESP constructed during that Phase. The total area of temporary disturbance estimated during installation of the inter-array cables during both Phase 1 and Phase 2 is 1,022 acres, while the total permanent footprint of anticipated cable protection during both phases is 45 acres (Epsilon 2022).

The IAC segments would be installed within a 1.3-foot (1-m) wide corridor between the WTGs with a width of 9.8 feet (3-m) disturbance when accounting for total skid/track width. Burial of the IAC would typically target a depth of 5 to 8 feet (1.5 m to 2.5 m) below sea floor with depth based on an assessment of sea floor conditions, mobility, and risk of interaction with external hazards such as fishing gear and vessel anchors, as well as the Cable Burial Risk Assessment (COP Appendix J). The IAC, as well as the ESP-link cable and NEWEC, would consist of three bundled copper or aluminum conductor cores surrounded by layers of cross-linked polyethylene insulation and various protective armoring and sheathing to protect the cable from external damage and keep it watertight. A fiber optic cable would also be included in the interstitial space between the three conductors and would be used to transmit data from each of the WTGs to the Supervisory Control and Data Acquisition system for continuous monitoring of the IAC.

Installation of the IAC would generally follow similar sequence as described for the NEWEC, below.

The ESPs would be connected by a 66 to 275 kV inter-link cable. The ESP-link cable allows electricity transmission to be balanced between NEWEC circuits. ESP-link cable installation methods would be similar to those described below for the NEWEC. The NEWEC would transfer electricity from the ESPs to the Onshore Export Cable, the portion of the export cable from the landfall site that connects to the onshore substation. The Offshore and Onshore Export Cables will be connected using transition vaults. The NEWEC corridor would be located in both federal and Massachusetts State waters (see Figure 3.1).

The sequence of events required for NEWEC construction and installation would include pre-lay cable surveys, sea floor preparation, cable installation, joint construction, cable installation surveys, cable protection, and connection to the ESPs. Construction of the NEWEC would require approximately 8-9 months in Phase 1 and 3-17 months in Phase 2. Table 3.8 below summarizes the NEWEC construction phases.

Table 3.8. Summary of NEWEC Construction and Installation Sequence.

Activity	Construction and Installation Summary
Pre-Lay Cable Surveys	Prior to installation, geophysical surveys would be performed to check for debris and obstructions that may affect cable installation
Seabed Preparation	Seabed preparation would include boulder clearance and removal of debris and any subsea utilities (e.g. Out of Service Cables). Boulder clearance trials may be performed prior to wide-scale seabed preparation activities to evaluate efficacy of boulder clearing techniques. Proposed boulder clearance methods comprise a boulder grab tool suspended from a vessel crane or a boulder plow towed along the route to push boulders aside.
Pre-Lay Grapnel Run (PLGR)	PLGR runs would be undertaken to remove any seabed debris along the export cable route. A specialized vessel would tow a grapnel rig along the centerline of each cable to recover any debris to the deck for disposal at a permitted onshore location.
Cable Installation	The offshore cable-laying vessel would move along the pre-determined route within the established corridor towards the ESPs. 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. Alternatively, a trench may be pre-cut prior to cable installation. A jet plow or mechanical plow may be used for cable installation. Jetting by controlled flow excavation would be used in limited locations such burying deeper to avoid needing cable protection (after an initial burial does not reach sufficient depth) or to bury cable joints.

Activity	Construction and Installation Summary
Joint Construction	Installation of the NEWEC would require offshore subsea joints due to the length of the NEWEC (up to three per cable). The joints would be located within the 10-ft (3-m) wide disturbance corridor.
Cable Installation Surveys	Cable installation surveys would be required, including pre- and post-installation surveys, to determine the actual cable burial depth. Depending on the instruments selected, type of survey, length of cable, etc. the survey would be completed by equipment mounted to a vessel and/or remote operated vehicle.
Cable Protection	Cable protection in the form of rock berms, rock bags, mattresses, and/or half-shell pipes would be installed as determined necessary by the Cable Burial Risk Assessment, and where the cable crosses existing submarine assets. Cable protection would be installed from an anchored or dynamic positioning support vessel that would place the protection material over the designated area(s). It is conservatively estimated that 6% of the offshore export cables within the OECC could require cable protection.
Connection to ESP and WTGs	Export cable ends would be pulled into each WTG and ESP foundation via a J-tube connected to the monopile foundation and secured. Cable protection systems would be installed on top of foundation scour protection.

source: BOEM's BA (BOEM 2023).

Burial of the NEWEC would be approximately 5 to 8 feet (1.5 m to 2.5 m) below sea floor. Burial depth may be deeper in some areas based on an assessment of sea floor conditions, sea floor mobility, risk of interaction with external hazards such as fishing gear and vessel anchors, and a Cable Burial Risk Assessment. Where burial cannot occur, or depth not achieved, or where cable crosses other cables/pipelines, additional cable protection methods may be used (e.g., rock berms/bags, concrete mattresses). Park City anticipates up to 6 percent of the route for each cable comprising the NEWEC will require additional protection measures. One or more of the following cable protection solutions may be used for secondary cable protection:

- Half Shell Pipes – composite materials and/or cast iron with suitable corrosion protection and are fixed around the cable to provide mechanical protection. Half-shell pipes are not used for remedial cable protection but could be used at cable crossings or where cable must be laid on the surface of the seabed.
- Concrete Mattresses – composed of cast concrete blocks interlinked to form a flexible, articulated mat, which can be placed on the sea floor over a cable.
- Gabion Rock Bags – rock-filled mesh bags placed over the cable.
- Rock – Rocks laid on top of the cable to provide protection.

Sea-to-Shore Connection
In the BA, for Phases 1 and 2, there are four landfall sites identified in Massachusetts: Covell's Beach, Craigville Beach, Dowses Beach, and Wianno Avenue. In the event that the South Coast Variant is selected for Phase 2, it would require the identification of an additional landfall site. We note that selection of the South Coast Variant, or any change in the cable routes or landfall sites identified in the BA, would necessitate determining if reinitiation of this consultation is required.

The NEWEC would transition from offshore to onshore using Horizontal Directional Drilling (HDD). HDD would involve drilling underneath the sea floor using a drilling rig positioned onshore in the landfall envelope; the maximum design envelope for the HDD methodology includes boring one hole for each offshore export cable. At either landfall site for Phase 1 (Covell's Beach and Craigville Public Beach), the HDD would have a length of 1,000-1,200 ft (300-365 m). For Dowes Beach, the process and details are similar for those in Phase 1, and the HDD length would be approximately 1,000–1,400 ft (300-427m). Wianno Avenue is considered less suitable for HDD, and open trenching is being considered as an alternative. No cofferdams are planned and cofferdam installation and removal is not described in the BA or the proposed MMPA ITA.

3.3 Operations and Maintenance (O&M)
As described in the COP and BA, the WTGs will be designed to operate without attendance by any operators. Continuous monitoring will be conducted remotely using a SCADA system. Routine preventative maintenance and inspections will be performed for all offshore facilities. The O&M facilities, anticipated to be located in Bridgeport, CT or Vineyard Haven or New Bedford, MA may include management and administrative team offices, a control room, office and training space for technicians and engineers, warehouse space for parts and tools, and/or pier space for vessels used during O&M. The BA does not describe any in-water construction or other work described with building or preparing any O&M facility. The WTGs would remain operational when not shut down for maintenance or when wind speeds are above or below operational cutoff thresholds. Maintenance activities would typically be planned for periods of low wind and good weather (typically during spring and summer seasons), mostly during daylight hours.

A summary of the WTG maintenance activities and the maximum frequency at which they are anticipated to occur is provided in Table 3.9, below.

Table 3.9. Summary of WTG Maintenance Activities.

Maintenance/Survey Activity	Indicative Frequency
Routine Service & Safety Surveys/Checks	Annual
Oil and HV Maintenance	Annual
Visual Blade Inspections (Internal and External)	Annual
Fault Rectification	As needed
Major Replacements	As needed
End of Warranty Inspections	At end of warranty period

Source: New England Wind COP June 2022 (Epsilon 2022)

A summary of the WTG and ESP foundation maintenance activities and the anticipated frequency at which they are expected to occur is provided in Table 3.10.

Table 3.10. Foundation Maintenance Activities.

Maintenance/Survey Activity	Indicative Frequency
Above Water Inspection & Maintenance	Annual
Sea Floor Survey	Underwater inspections for 20% of foundations each year during the first five years of operation (i.e. all foundations are expected to be inspected once during the first five years). After the first five years of operations, the frequency of surveys may be adjusted over time based on results of the ongoing surveys.
Corrective Maintenance	As needed
End of Warranty Inspections	At end of warranty period

Source: New England Wind COP June 2022 (Epsilon 2022)

Each WTG would require various oils, fuels, and lubricants to support O&M. Sulfur hexafluoride (SF_6) would also be used for insulation purposes. Table 3.11 provides a summary of the maximum quantities of these materials potentially required for each WTG. The spill containment strategy for each WTG comprises similar preventive, detective, and containment measures to those described for the ESPs. 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 integrated retention reservoirs capable of containing 110 percent of the volume of potential leakages at each WTG. Additionally, WTG switchgear containing SF_6 will be equipped with integral low-pressure detectors to detect SF_6 gas leakages should they occur.

Table 3.11. Summary of the Maximum Potential Quantities of Oils, Fuels, Lubricants per WTG.

WTG System/Component	Material	Maximum Quantity per WTG
WTG Bearings, Yaw, and Pitch Pinyons	Grease	383.6 gallons (1,452 liters)
Hydraulic system (pitch, low-speed brake, cranes, & winches)	Hydraulic Oil	420 gallons (1,590 liters)
Drive Train Gearbox (if applicable), Yaw/Pitch Drives Gearbox	Gear Oil	1,400 gallons (5,300 liters)
Drives pitch system during power failure	Nitrogen (pressurized)	198 pounds (90 kg)
High-Voltage Transformer	Transformer Silicon/Ester Oil	3,011.6 gallons (11,400 liters)
Emergency Generator	Diesel Fuel	1,849 gallons (7,000 liters)*
Tower Damper and Cooling System	Glycol/Water	6,023 gallons (22,800 liters)
Lubricant	Tower damper fluid	4,332 gallons (16,400 liters)

Sulfur hexafluoride (SF_6)	Insulates switchgear	

Source: New England Wind COP June 2022 (Epsilon 2022)
* Emergency generator may be housed on the WTG or brought to the WTG during commissioning or in an emergency power outage in which battery backup, power from other WTGs, or shore power was not available.

In the COP, Park City describes the preventative maintenance that will be carried out to support the ESPs and cables. For ESPs, inspections and service of high-voltage equipment (e.g. transformers, switchgears, earthing systems) and auxiliary systems (e.g. fire protection system, communication system, heating and ventilation system). and statutory inspections of lifting equipment, safety equipment, hook-on points, etc. will be carried out on a routine basis. For the cables, maintenance activities include: High resolution geophysical surveys (more information below) and monitoring cable exposure and/or depth of burial. It is expected that the cables will be surveyed within six months of commissioning, at years one and two, and every three years thereafter. The cable design may include a Distributed Temperature System (DTS) to monitor the temperature of the cable at all times; significant changes in temperature recorded by the DTS may also be used to indirectly indicate cable exposure.

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.

3.4 Decommissioning

The NEWF and NEWEC would be decommissioned and removed at the end of their approximately 30-year operating period. BOEM's decommissioning requirements are stated in Section 13, *Removal of Property and Restoration of the Leased Area on Termination of Lease*, of the Lease for OCS-A 0534. Unless otherwise authorized by BSEE, pursuant to the applicable regulations in 30 CFR Part 285, Park City 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, Park City 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 operational period. Before ceasing operation of individual WTGs or the entire Project and prior to decommissioning and removing Project components, Park City 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, Park City would implement the decommissioning plan to remove, and recycle, when possible, equipment and associated materials.

For both WTGs and ESPs, decommissioning would be a "reverse installation" process, with turbine components or the ESPs topside structure removed prior to foundation removal. The blades, rotor, nacelle, and tower would be sequentially disassembled and transported to port for processing using vessels and cranes similar to those used during construction. The ESPs are expected to be disassembled in a similar manner as the WTGs, using similar vessels. Prior to dismantling, the ESP(s) would be properly drained of all oils, lubricating fluids, and transformer oil. Cables will be removed, in accordance with BSEE regulations (30 CFR 285, Subpart I). A material barge would transport components to a recycling yard where the components would be disassembled and prepared for reuse and/or recycling for scrap metal and other materials.

The foundations will be cut by an internal abrasive water jet-cutting tool at 15 feet BML and returned to shore for recycling in the same manner described for the WTG components and the ESPs. The offshore cables could be retired in place or removed, subject to authorization by BOEM and/or BSEE and any other necessary approvals. Park City will be required to completely remove all transmission cables from the sediment to the extent practicable and remove all associated cable protection from the sea floor. Any cable segments that cannot be fully extracted would be cut off using a cable saw and buried at least 4 to 6 feet BML. All remaining components would be completely removed from the environment and collected for recycling of valuable metals and other materials. Park City will clear the area after all components have been decommissioned to ensure that no unauthorized debris remains on the sea floor. Onshore decommissioning requirements will be subject to state/local authorizations and permits.

3.5 Surveys and Monitoring

Park City is proposing to carry out or BOEM is proposing to require that Park City 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 for which BOEM has requested consultation.

3.5.1 High-Resolution Geophysical 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 WTG and ESP 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. Equipment may be mounted to the survey vessel or the Project may use autonomous surface vehicles (SFV) to carry out this work. HRG survey vessels move slowly, with typical operational speeds of less than approximately 4 knots.

These surveys are expected to utilize active acoustic equipment; as described in the Notice of Proposed MMPA ITA, the equipment will include medium penetration sub-bottom profilers (SBPs) (boomers and sparkers), ultra-short baseline, innomar, and other parametric sub-bottom profilers, sidescan sonar, synthetic aperture sonar, and marine magnetometers/gradiometers. Surveys would occur annually, with durations dependent on the activities occurring in that year (i.e., construction year versus a non-construction year), with a total of up to 25 survey days planned per 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.

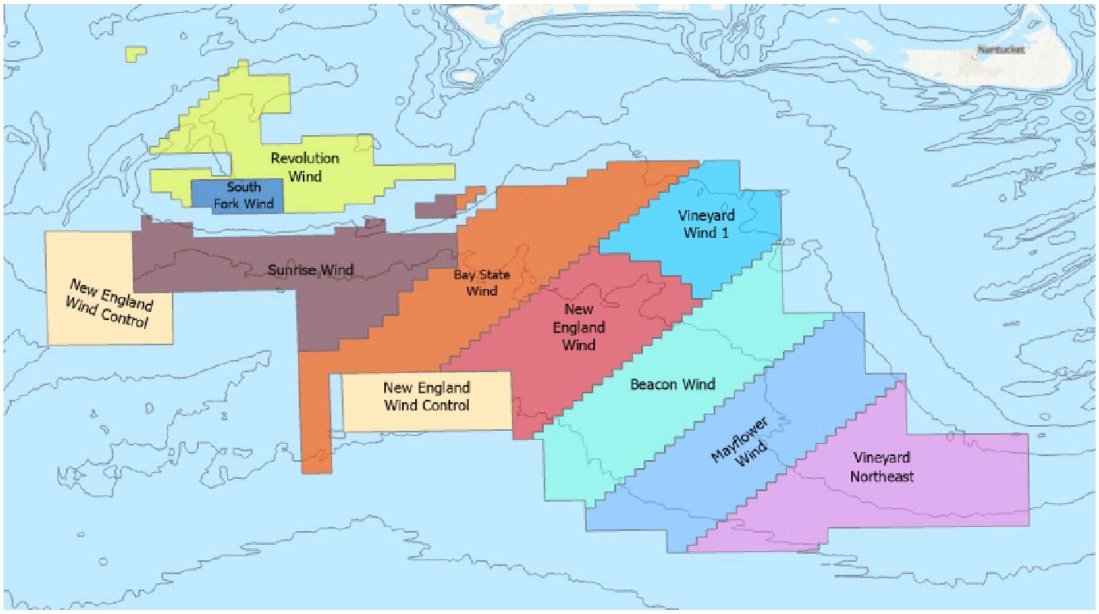
BOEM has completed a programmatic ESA consultation with NMFS for HRG surveys and other types of survey and monitoring activities supporting offshore wind energy development (NMFS 2021a; Appendix C to this Opinion). As described in the New England Wind BA, BOEM will require Park City to comply with all 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 New England Wind 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.

HRG surveys would utilize up to a maximum of three vessels working concurrently in different sections of the lease area and NEWEC corridor. Park City estimates that 18,000 km would be surveyed over 225 vessel days in the lease area within 3 years across the 5 year period. Each day that a survey vessel covers 80 km (50 miles) of survey trackline is considered a vessel day. HRG surveys would occur in the WDA and extending along the OECC in water depths ranging from 1 m (3.6 ft) to 61.9 m (203 ft). Park City anticipates that each vessel would survey an average of 50 miles (80 km) per day, assuming a 7.4 km/hour (4 knots) vessel speed and 24-hour operations. HRG surveys would be conducted at any time of year. In this schedule, Park City accounted for periods of downtime due to inclement weather or technical malfunctions.

3.5.2 Fisheries and Benthic Monitoring

Park City is proposing to implement their Fisheries Research and Monitoring Plan (FRMP; New England Wind 2023); in the BA, BOEM identified this as part of the Proposed Action for this ESA consultation. The FRMP was provided to NMFS in May 2023; during the consultation period, Park City confirmed that their ventless trap surveys would be carried out with ropeless/on demand technology. All surveys are proposed for a six year period. Survey and control areas are illustrated in Figure 3.3.

Figure 3.3 Proposed Control Areas and Survey Area (New England Wind Lease Block) (source: Figure 4, New England Wind FRMP 2023).



Ventless Trap Surveys

Ventless trap surveys will be used to evaluate changes in the distribution and abundance of lobsters and crabs in the WDA and adjacent reference areas while supporting an additional black sea bass study. As noted above, there will be no vertical lines used to mark gear, as all deployments will use ropeless/on demand technology. All groundlines will be constructed of sinking line.

Ventless traps will be set at fifteen locations within the NEWF and fifteen reference locations in two control areas adjacent to the NEWF to the west and southwest of the lease area (see Figure 10 in the FRMP). The ventless trap survey will modify the existing cooperative, random stratified ventless trap survey sampling approach employed in the Southern New England Cooperative Ventless Trap Survey (SNECVTS) (Collie and King 2016). Thirty strings split between the control and development areas will be deployed between May and December, with six traps per string alternating vented and ventless. A single fish pot will be added to each string of lobster traps to collect general information on black sea bass as well as their predation rates on lobsters. Deployment stations will be distributed through the lease and control areas in a BACI design (see Figure 10 in the FRMP) and will be reselected each year. Between monthly sampling sessions, all gear will be removed from the water and stored on land. The standard soak time will be three days before hauling, with a goal of two hauls per month. Traps will be baited with locally available bait (likely skate), and the bait type will be recorded for each trawl. Each trap string contains a total of 6 pots, alternating between vented and ventless traps. The dimensions for all traps are standardized at 40 inches long, 21 inches wide, and 16 inches high throughout all survey areas. They contain a single kitchen, parlor, and rectangular vent in the parlor of vented traps that is 15/16 inches long and 5 ¾ inches wide. The survey is proposed to take place for six years.

Neuston Net Sampling
Zooplankton sampling with neuston tows for larval lobster and other organisms would be done at 30 stations across the WDA and control areas in conjunction with the ventless trap survey. Each station would be sampled twice per month from May to December. The Neuston net frame is 2.4 meters by 0.6 meter by 6.0 meters (7.8 feet by 1.9 feet by 19.6 feet) in size, and the net is made of a 1,320-micrometer mesh. At the end of the net is a codend for collecting samples. This survey would consist of 10-minute tows at 4 knots in the top 1.6 feet (0.5 meter) of the water column at 30 stations. The survey is proposed to take place for six years.

Demersal Otter Trawl Surveys
Otter trawl surveys will be carried out to assess abundance and distribution of target fish and invertebrate species. The survey will encompass the approximately 411 km^2 of OCS-A 0534 and with a control area of similar size and depths. A total of 50 tows will be split evenly between the lease and control areas during four seasonal campaigns each year: Spring (April-June), Summer (July-September), Fall (October-December), and Winter (January-March). Tow locations within the study areas will be selected using a spatially balanced sampling design with a total of 200 tows per year. The starting location of each tow in each sub-area will be randomly selected. The survey will be set up using a BACI framework and collect data on aggregated species weights, individual sampling data (length, weigh, etc.), and oceanographic conditions. The otter trawl survey will use a methodology adapted from the Atlantic States Marine Fisheries Commission (ASMFC) NEAMAP nearshore trawl surveys. The survey trawl will be towed for 20 minutes at each station at 3.0 knots (5.6 km/hour). The net planned for use is a 400 centimeter (cm) x 12 centimeter (cm), three-bridle, four-seam bottom trawl and is paired with Thyboron Type IV 66" trawl doors. A 12 cm diamond mesh codend with a 1" knotless liner will be used to sample marine taxa across a broad range of size and age classes.

Drop Camera
Three cameras (digital still and video) would be deployed as part of the benthic optical drop camera survey to identify the substrate, as well as invertebrate and fish species that associate with the seafloor (Bethoney and Stokesbury 2018). The survey would have four quadrats sampled at each station. Survey stations would be located on an approximately 1.5-kilometer (0.9-mile) grid throughout the WDA and control area with 182 stations in the WDA and 186 stations in the control area, for a total of 368 station in a single survey (BOEM 2023). The control area has similar depth and habitat characteristics as the WDA. During the survey, a sampling pyramid, supporting cameras, and lights would be deployed from a commercial scallop fishing vessel. Surveys would be conducted twice annually between April and September at the 368 stations within the WDA and control areas. Each survey would last approximately 6 days (BOEM 2023).

Acoustic Telemetry – Highly Migratory Species
To complement existing studies, Park City will maintain 6 acoustic telemetry receivers within the New England Wind lease area and surrounding waters. Receivers are deployed on the bottom, consistent with manufacturer recommendations. In the spring and fall of each year, acoustic receivers will be summoned, downloaded, cleaned, and re-deployed. Receiver deployment and maintenance will be done primarily in collaboration with a local commercial fishing vessel. No fish will be collected or tagged as part of this effort.

Benthic Monitoring
Park City will monitor impacts and changes to hard-bottom and soft-bottom habitat in response to construction disturbance and habitat modification. Hard bottom monitoring will focus on measuring changes in percent cover, species composition, and volume of macrofaunal attached communities using a combination of acoustic survey and remotely operated vehicle imaging techniques. Techniques for the monitoring include grab sampling, multibeam bathymetric surveys, and underwater video pre- and post-construction. Surveys will occur at 1-, 3-, and if necessary, 5-years post-construction. Both BACI and BAG sampling designs would be used, with sample stations at regular distances from the scour protection or OECC, impact monitoring transects, and sample stations placed outside of the impacted area to serve as controls. The total duration of survey work is expected to last 30 to 60 days annually, including weather downtime.

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 may occur prior to, during, and following construction in coordination with regional PAM network partners under BOEM's Partnership for an Offshore Wind Energy Regional Observation Network (POWERON). BOEM will require the archival recorders have a minimum capability of detecting and storing acoustic data on anthropogenic noise sources, and vocalizing marine mammals, in the Lease Area.

Meteorological or other data collection buoys to provide real-time weather or other data may 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.

3.6 Vessels and Aircraft Proposed for the New England Wind Project
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.

Park City 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 to five year period.

Table 3.12 Representative Vessels Proposed for Use for Project Construction
(source: BA Table 1-12)

Vessel Role	Expected Vessel Type	Number of Vessels	Approximate Vessel Speed: Typical Operational Speed (Knots)	Approximate Vessel Speed: Maximum Transit Speed (Knots)	Estimated Number of Round Trips: Both Phases	Estimated Number of Round Trips: Phase 1	Estimated Number of Round Trips: Phase 2
Foundation installation							
Scour protection installation	Scour protection installation vessel (e.g., fall-pipe vessel)	1	10–14	14	130	64	79
Overseas foundation transport	Heavy transport vessel	2–5	12–18	12–18	51	26	32
Foundation installation (possibly including grouting)	Jack-up vessel or heavy lift vessel	1–2	0–10	6.5–14	4	2	2
Tugboat to support main foundation installation vessel(s)	Tugboat	1	10–14	10–14	21	10	13
	Barge	2–5	10–14	10–14			
Transport of foundations to SWDA	Tugboat	2–5	8–10	10–14	48	24	30
Secondary work and possibly grouting	Support vessel or tugboat	1	10–14	14	134	65	81
Crew transfer	Crew transfer vessel	1–3	10–25	25	266	129	161
Noise mitigation	Support vessel or anchor handling tug supply vessel	1	10	13	21	10	13
Acoustic monitoring	Support vessel or tugboat	1	10–14	14	21	10	13
Marine mammal observers and environmental monitors	Crew transfer vessel	2–6	10	25	798	387	483
ESP installation							
ESP installation	Heavy lift vessel	1	0–12	6.5–14	2	1	1

Vessel Role	Expected Vessel Type	Number of Vessels	Approximate Vessel Speed		Estimated Number of Round Trips		
			Typical Operational Speed (Knots)	Maximum Transit Speed (Knots)	Both Phases	Phase 1	Phase 2
Overseas ESP transport	Heavy transport vessel and/or tugboat	1–2	10–18	13–18	24	10	14
ESP transport to SWDA (if required)	Heavy transport vessel and/or tugboat	1–4	0–14	14			
Crew transfer	Crew transfer vessel	1	10–25	25	602	301	301
Service boat	Crew transfer vessel or support vessel	1	10–25	25	22	11	11
Crew accommodation vessel during commissioning	Jack-up	1	0–6	6	6	3	3
	Accommodation vessel	1	10	13.5			
Offshore export cable installation							
Pre-lay grapnel run	Support vessel	1	4–15	15	86	31	55
Pre-lay survey	Survey vessel or support vessel	1	4–14	25–30	107	39	68
Boulder clearance	Support vessel	1	5–12	12	152	55	97
Dredging	Dredging vessel	1	10–16	16	4	2	2
Cable laying (and potentially burial)	Cable-laying vessel	1–2	5–8	14	12	4	8
Trenching (*moved from below*)	Cable-laying vessel or support vessel	1	10	15			
Support main vessel with anchor handling	Tugboat or anchor handling tug supply vessel	1–3	5–14	10–14	24	8	16
Cable landing	Tugboat, jack-up vessel, or anchor handling tug supply vessel	1	10–14	10–14	12	5	7
Shallow water cable burial	Cable-laying vessel	1	0–10	10	7	3	4

Vessel Role	Expected Vessel Type	Number of Vessels	Approximate Vessel Speed		Estimated Number of Round Trips		
			Typical Operational Speed (Knots)	Maximum Transit Speed (Knots)	Both Phases	Phase 1	Phase 2
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	1	10–14	14	6	2	4
Crew transfer	Crew transfer vessel	1	10–25	25	162	58	103
Safety vessel	Crew transfer vessel	1	10–25	25	88	35	53
Inter-array cable installation							
Pre-lay grapnel run	Support vessel	1	4–15	15	18	9	12
Pre-lay survey	Survey vessel or support vessel	1	4–14	25–30	18	9	12
Cable laying (and potentially burial)	Cable-laying vessel	1	5–8	14	8	4	5
Cable installation support	Support vessel	1	5–12	12	10	5	7
Crew transfer	Crew transfer vessel	2	10–25	25	604	286	412
Cable termination and commissioning	Support vessel	1	10–12	12	18	9	12
Trenching	Cable-laying vessel or support vessel	1	10–15	15	18	9	12
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	1	10–14	14	10	5	7
Safety vessel	Crew transfer vessel	1	10–25	25	24	11	16

Vessel Role	Expected Vessel Type	Number of Vessels	Approximate Vessel Speed		Estimated Number of Round Trips		
			Typical Operational Speed (Knots)	Maximum Transit Speed (Knots)	Both Phases	Phase 1	Phase 2
WTG installation and commissioning							
Overseas WTG transport	Heavy transport vessel	1–5	14–18	14–18	86	42	53
Overseas transport of WTG installation vessel(s)	Heavy transport vessel	1	10–11.5	11.5	4	2	2
WTG transport to SWDA	Jack-up vessels or tugboat	2–6	0–10	13–14	137	65	84
WTG transport assistance	Tugboat	1–6	0–10	13–14	60	28	36
WTG installation	Jack-up vessel or heavy lift vessel	1–2	0–10	8–13	34	17	21
Crew transfer	Crew transfer vessel	3	10–25	25	341	166	210
WTG commissioning vessel	Service operations vessel	1	10–12	13	36	17	22
Miscellaneous construction activities							
Crew transfer	Crew transfer vessel or service operations vessel	1–4	10–25	25	2,3 36	1,168	1,168
Refueling	Crew transfer vessel or support vessel	1	10–25	25	46	21	28
Geophysical, geotechnical, and UXO survey operations	Survey vessel or support vessel	1–3	4–14	25–30	34	16	21

Table 3.13: Size of Representative Vessels Used for Proposed Project Construction

Vessel Role	Vessel Type	Approximate Size	
		Width	**Length**
Foundation installation			
Scour protection installation	Scour protection installation vessel (e.g., Fall-pipe Vessel)	30–45 meters (98–148 feet)	130–170 meters (427–558 feet)
Overseas foundation transport	Heavy transport vessel	24–56 meters (79–184 feet)	120–223 meters (394–732 feet)
Foundation installation (possibly including grouting	Jack-up vessel or heavy lift vessel	40–106 meters (131–346 feet)	154–220 meters (505–722 feet)
Tugboat to support main foundation installation vessel(s)	Tugboat	6–10 meters (20–33 feet)	16–35 meters (52–115 feet)
Transport of foundations to SWDA	Barge	~25 meters (82 feet)	100 meters (328 feet)
Transport of foundations to SWDA	Tugboat	~10 meters (33 feet)	~35 meters (115 feet)
Secondary work and possibly grouting	Support vessel or tugboat	~10 meters (33 feet)	30–80 meters (98–262 feet)
Crew transfer	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Noise mitigation	Support vessel or anchor handling tug supply vessel	~15 meters (49 feet)	65–90 meters (213–295 feet)
Acoustic monitoring	Support vessel or tugboat	~10 meters (33 feet)	~30 meters (98 feet)
Marine mammal observers and environmental monitors	Crew transfer vessel	~7 meters (23 feet)	~20 meters (66 feet)
ESP installation			
ESP installation	Heavy lift vessel	40–106 meters (131–346 feet)	154–220 meters (505–722 feet)
Overseas ESP transport	Heavy transport vessel	24–40 meters (79–131 feet)	20–223 meters (66–732 feet)
ESP transport to SWDA (if required)	Tugboat	~10 meters (33 feet)	~35 meters (115 feet)
Crew transfer	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Service boat	Crew transfer vessel or support vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Refueling operations to ESP	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Crew accommodation vessel during commissioning	Jack-up	~40 meters (131 feet)	~55 meters (180 feet)
	Accommodation vessel	10–12 meters (33–39 feet)	70–100 meters (230–328 feet)

Vessel Role	Vessel Type	Approximate Size	
		Width	Length
Offshore export cable installation			
Pre-lay grapnel run	Support vessel	8–15 meters (26–49 feet)	30–70 meters (98–230 feet)
Pre-lay survey	Survey vessel or support vessel	6–26 meters (20–85 feet)	13–112 meters (43–367 feet)
Cable laying (and potentially burial)	Cable-laying vessel	22–35 meters (72–115 feet)	80–150 meters (262–492 feet)
Boulder clearance	Support vessel	15–20 meters (49–66 feet)	75–120 meters (246–394 feet)
Support main vessel with anchor handling	Tugboat or anchor handling tug supply vessel	6–15 meters (20–49 feet)	16–65 meters (52–213 feet)
Trenching	Cable-laying vessel or support vessel	~25 meters (82 feet)	~128 meters (420 feet)
Crew transfer	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	30–45 meters (98–148 feet)	130–170 meters (427–558 feet)
Dredging	Dredging vessel	~30 meters (98 feet)	~230 meters (755 feet)
Cable landing	Tugboat or jack-up vessel	6–15 meters (20–49 feet)	16–65 meters (52–213 feet)
Shallow water cable burial	Cable-laying vessel	13 meters (43 feet)	34 meters (112 feet)
Safety vessel	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Inter-array cable installation			
Pre-lay grapnel run	Support vessel	8–15 meters (26–49 feet)	30–70 meters (98–230 feet)
Pre-lay survey	Survey vessel or support vessel	6–26 meters (20–85 feet)	13–112 meters (43–367 feet)
Cable laying (and potentially burial)	Cable-laying vessel	22–35 meters (72–115 feet)	80–150 meters (262–492 feet)
Cable installation support	Support vessel	15–20 meters (49–66 feet)	75–120 meters (246–394 feet)
Crew transfer	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)
Cable termination and commissioning	Support vessel	15–20 meters (49–66 feet)	75–120 meters (246–394 feet)
Trenching	Cable-laying vessel or support vessel	21–25 meters (69–82 feet)	95–128 meters (311–420 feet)
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	30–45 meters (98–148 feet)	130–170 meters (427–558 feet)
Safety vessel	Crew transfer vessel	7–12 meters (23–39 feet)	20–30 meters (66–98 feet)

Vessel Role	Vessel Type	Approximate Size	
		Width	Length
WTG installation			
Overseas WTG transport	Heavy transport vessel	15–20 meters (49–66 feet)	130–150 meters (427–492 feet)
Overseas transport of WTG installation vessel(s)	Heavy transport vessel	~56 meters (184 feet)	~214 meters (702 feet)
WTG transport to SWDA	Jack-up vessels or tugboat	6–50 meters (20–164 feet)	35–100 meters (115–328 feet)
WTG transport assistance	Tugboat	6–12 meters (20–40 feet)	15–38 meters (49–125 feet)
WTG installation	Jack-up vessel or heavy lift vessel	35–55 meters (115–180 feet)	85–165 meters (279–541 feet)
Crew transfer	Crew transfer vessel	~7 meters (23 feet)	~20 meters (66 feet)
WTG commissioning			
WTG commissioning vessel	Service operations vessel	~18 meters (59 feet)	~80 meters (262 feet)
Crew transfer	Crew transfer vessel	6–12 meters (20–39 feet)	15–30 meters (49–98 feet)
Miscellaneous Construction Activities			
Refueling	Crew transfer vessel or support vessel	~7 meters (23 feet)	~20 meters (66 feet)
Safety vessel	Crew transfer vessel	~7 meters (23 feet)	~20 meters (66 feet)
Geophysical and geotechnical survey operations	Survey vessel or support vessel	6–26 meters (20–85 feet)	13–112 meters (43–367 feet)

In the BA, BOEM identifies the port facilities in the U.S. expected to be used by project vessels. No new port facilities or facility upgrades are included as part of the proposed action undergoing consultation.

Table 3.14. Potential Ports Used for Construction, Operations, and Decommissioning of the Proposed Action

Geography	Ports
Massachusetts	New Bedford Marine Commerce Terminal, other areas in New Bedford Harbor, Brayton Point Commerce Center, Vineyard Haven, Fall River, Salem
Rhode Island	Port of Davisville, Port of Providence, South Quay Terminal
Connecticut	Bridgeport, New London State Pier
New York	Capital Region ports (Port of Albany, Coeymans, and New York State Offshore Wind Port), Staten Island Ports (Arthur Kill and Homeport Pier), South Brooklyn Marine Terminal, GMD Shipyard, Shoreham
New Jersey	Paulsboro
Atlantic Canada	Halifax, Nova Scotia; Sheet Harbor, Nova Scotia; Saint John, New Brunswick
Europe	Specific ports currently unknown

In the BA and supplemental information, BOEM identifies the potential for up to 400 transits of a heavy transport vessel carrying project components from ports in Europe directly to the WDA or one of the identified US ports. These trips will occur at some time during the 3-5-year construction phase. The ports that these vessels will originate from in Europe and the vessel routes from those port facilities to the project site are unknown and will be variable and depend, on a trip-by-trip basis, on weather and sea-state conditions, other vessel traffic, and any maritime hazards.

Table 3.15. Representative Vessels Used for Proposed Project Construction that may Transit to and from Europe (BOEM 2023)

Vessel Role	Expected Vessel Type	Number of Vessels
Foundation installation		
Scour protection installation	Scour protection installation vessel (e.g., fall-pipe vessel)	1
Overseas foundation transport	Heavy transport vessel	2–5
Foundation installation (possibly including grouting)	Jack-up vessel or heavy lift vessel	1–2
ESP installation		
ESP installation	Heavy lift vessel	1
Overseas ESP transport	Heavy transport vessel and/or tugboat	1–2
Offshore export cable installation		
Cable laying (and potentially burial)	Cable-laying vessel	1–2
Trenching	Cable-laying vessel or support vessel	1
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	1
Inter-array cable installation		
Cable laying (and potentially burial)	Cable-laying vessel	1
Cable installation support	Support vessel	1
Trenching	Cable-laying vessel or support vessel	1
Install cable protection	Cable protection installation vessel (e.g., fall-pipe vessel)	1
WTG installation and commissioning		
Overseas WTG transport	Heavy transport vessel	1–5
Overseas transport of WTG installation vessel(s)	Heavy transport vessel	1
WTG installation	Jack-up vessel or heavy lift vessel	1–2
	Total Number of Vessels	**16–27**

Table 3.16. Maximum Scenario of Vessel Trips to Ports included in the BA - During Project Construction.

	Peak Construction Period	Entire Construction Period	
Ports	Average Round Trips Per Month	Average Round Trips Per Month	Approximate Total Round Trips[a]
All ports	443	215	6,700
New Bedford Harbor (MA)	443	209	6,500
Bridgeport (CT) Vineyard Haven (MA) Port of Davisville (MA) South Quay Terminal (MA)	376	177	5,500
Port of Providence (RI) Brayton Point Commerce Center (RI) Fall River (MA) New London State Pier (CT) Staten Island ports (NY) South Brooklyn Marine Terminal GMD Shipyard (NY) Shoreham (NY)	162	68	2,100
Salem Harbor (MA)	46	20	610
Canadian ports	38	21	620
European ports	31	13	400
Capital Region ports (Albany and Coeymans, NY) - Hudson River Paulsboro (NJ) - Delaware River	6	3	100

a - A total of 6,700 round trips is anticipated during the construction of the project (inclusive of Phase 1 and 2). The number of trips per port is uncertain at this time. The total round trips listed for each group of ports in the table is the maximum number of

trips anticipated to occur from that set of ports (e.g., up to 100 trips may occur from some combination of Paulsboro, NJ, Albany, NY, and Coeymans, NY)
Source: Table 1-10 BOEM's BA

As described in the BA, Park City has estimated that Project O&M would involve up to 6 and up to 15 vessels operating in the WFA or OECC during peak periods of activity based on maintenance needs. 250 round trips are estimated to take place during the O&M for Phase 1, with similar levels for Phase 2. During the simultaneous operation of both phases, approximately 470 vessel round trips are estimated to take place annually, though consolidating vessel trips for both phases could reduce this number. These trips would originate from an O&M facility located in Bridgeport, Connecticut; and, Vineyard Haven or New Bedford, Massachusetts. One or more CTVs ranging from 75 feet in length would service the NEWF over the life of the Project. SOVs are larger mobile work platforms, approximately 260 to 300 feet, equipped with dynamic positioning systems used for more extensive, multi-day maintenance activities. Larger vessels like those used for construction and installation could be required for unplanned maintenance, such as repairing scour protection or replacing damaged WTGs. Those activities would occur on an as-needed basis. Larger vessels would be based at the New Bedford Marine Commerce Terminal with smaller vessels based at the onshore operations facility located in Vineyard Haven, Massachusetts. Helicopters may also be used for aerial inspections.

The number and type of vessels required for project decommissioning would be similar to those used during project construction, with the exception that impact pile driving would not be required. As such, while the same class of vessel used for foundation installation may be used for decommissioning, that vessel would not be equipped with an impact hammer. 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.

3.7 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 Park City Wind, LLC 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 March 27, 2025 to March 26, 2030. More information on the proposed Incidental Take Regulation (ITR) and associated Letter of Authorization (LOA), including Park City Wind's application is available online (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-park-city-wind-llc-construction-new-england-wind-offshore-wind*). As described in the Notice of Proposed Rule (88 FR 37606; June 8, 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 foundation installation (impact and vibratory pile driving and drilling), detonation of unexploded ordnance (UXO/MEC), and vessel-based site assessment surveys using high-resolution geophysical (HRG) equipment. As noted above, Park City modified their request for an ITA during the consultation period and additional information, including revisions to the amount of take proposed for issuance and revisions to clearance zones were provided to us in December 2023 with corrections/refinements submitted into February 2024.

3.7.1 Amount of 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 mammals expected to result from activities during the construction phase of the project, with Level A take limited to blue, fin, sei, and sperm 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 Estimates

The methodology for estimating marine mammal exposure and incidental take is described fully in the Notice of Proposed ITA, JASCO 2023, 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 experience temporary threshold shift and/or 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 installation of foundation piles (impact and vibratory pile driving and drilling), UXO detonations, and HRG surveys (see Table 317).

Table 3.17. Total Take of ESA Listed Species by Level A Harassment and Level B Harassment Proposed for Authorization through the MMPA ITA, inclusive of HRG Surveys

Marine Mammal Species	Year 1		Year 2		Year 3		Year 4		Year 5		5-Year Total[2]	
	Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment	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	19	0	39	0	46	0	23	0	5	0	126
Blue whale	0	0	1	2	1	2	1	2	0	0	2	4
Fin whale	1	11	7	122	20	194	8	72	0	4	35	386
Sei whale[3]	1	6	2	17	3	27	2	15	0	2	8	66
Sperm whale	1	3	1	32	0	56	0	20	0	2	2	108

1 –Except for blue whales (which is based on group size instead of density), the 5-year total take for ESA-listed species is less than the sum of all years combined given that the maximum annual take across years is a combination of Schedule A and B. If the 5-year total take as a sum of take across all 5-years, it would represent take estimates from a greater number of foundations that are proposed to be installed. Due to its rarity, Park City assumes take for every other year during foundation installation, resulting in total take requested being less than the annual take summed.
2- PCW assumed one group of blue whales may be observed during 2 of the maximum 3 years of pile foundation work; hence, the 5-year total is less than the sum of all 3 pile installation years.
3- As a result of the new modeling, PCW has requested an additional sei whale by Level A harassment for both Year 3 and Year 4 than what was requested at the time of the proposed rule.
source: NMFS OPR, January 2024

Installation of Piles with Impact Hammer, Vibratory Hammer, and Drilling

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. This information was supplemented by the applicant in December 2023 (JASCO 2023) and in January and February 2024 (LOA Update Memo 2024, communication from OPR). Table 3.18 shows the proposed Level A and Level B take to be authorized resulting from impact pile driving, vibratory pile driving, and relief drilling for the installation of up to 133 WTG and ESP foundations, assuming 10 dB attenuation (as required by conditions of the proposed ITA).

Table 3.18. MMPA Take of ESA Listed Species by Level A and B Harassment Proposed for Authorization through the MMPA ITA Resulting from Pile Driving, including use of impact, vibratory, and drilling (Based on Construction Schedule B)

Species	Level A Harassment	Level B Harassment (TTS)
Blue whale	2	4
Fin whale	33	352
North Atlantic right whale	0	74
Sei whale	6	49
Sperm whale	0	96

source: NMFS OPR, January 2024, based on JASCO 2023 and 2024 LOA Update Memo

Potential UXO/MEC Detonations
As described in the Notice of Proposed ITA, for potential UXO detonations, acoustic modeling was conducted to determine distances to thresholds for behavioral disturbance, temporary threshold shift (TTS), permanent threshold shift (PTS), and non-auditory injury. Table 3.19 shows the amount of Level A and Level B harassment that NMFS OPR is proposing to authorize resulting from the detonation of 10 UXOs, assuming 10 dB of sound attenuation.

Table 3.19. MMPA Take of ESA Listed Species by Level A Harassment and Level B Harassment Proposed for Authorization through the MMPA ITA from the Detonation of up to 10 UXOs, Assuming 10 dB of Sound Attenuation

Species	Level A Harassment	Level B Harassment (TTS)
Blue whale	0	0
Fin whale	2	14
North Atlantic right whale	0	27
Sei whale	2	7
Sperm whale	2	2

source: Table 29, 88 FR 37606

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 A and Level B harassment take proposed for authorization by NMFS OPR is illustrated in Table 3.20.

Table 3.20. MMPA Take of ESA Listed Species by Level B Harassment Proposed for Authorization through the MMPA ITA Resulting from High-Resolution Geophysical Surveys (over 5-years)

Species	Level B Harassment
Blue whale	0
Fin whale	20
North Atlantic right whale	25
Sei whale	10
Sperm whale	10

source: Table 31, 88 FR 37606

3.7.2 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 Park City. The proposed ITA, inclusive of the proposed mitigation requirements, has been published in the FR (88 FR 37606). The proposed mitigation measures include restrictions on pile driving, establishment of clearance zones for all activities, 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, 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). The mitigation measures included in the June 2023 Proposed ITA are listed in Appendix B; changes to the clearance zones made during the consultation period are reflected in Table 3.21.

3.8 Minimization and Monitoring Measures that are part of the Proposed Action
There are a number of measures that Park City, through its COP, is proposing to take and/or BOEM and/or USACE is proposing to require as conditions of their respective authorizations that are designed to avoid, minimize, or monitor effects of the action on ESA listed species. For the purpose of this consultation, the mitigation 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 and Appendix B); these measures are also considered as part of the proposed action for this consultation. The 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 mitigation, monitoring, and reporting needs. The measures considered as part of the proposed action, and thus mandatory for implementation, are described in Table 1-15 of BOEM's BA and for ease of reference, 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 and aer copied into Appendix B of this Opinion. 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.

BOEM and NMFS OPR are proposing to require monitoring of clearance and shutdown zones before and during pile driving as well as clearance zones prior to UXO detonation. More information is provided in the *Effects of the Action* section of this Opinion. These zones are summarized in Table 3.21. In addition to the clearance and shutdown zones, the MMPA ITA identifies minimum visibility zones for pile driving of WTG and ESP foundations. These are the distances 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 or UXO 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 or UXO) 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 right whales within the identified PAM clearance zone for the identified amount of time. Pile driving or UXO detonation cannot commence until all of these clearances (i.e. visual and PAM) are made.

Once pile driving begins, the shutdown zone applies. There is no shutdown zone for UXO detonation as once a detonation begins it cannot be stopped; additionally, the duration of the detonation is extremely short (one second). If a marine mammal 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 Park City 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), or 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 Park City and/or its contractor determines shutdown is not feasible due to risk of injury or loss of life, reduced hammer energy must be implemented when the lead engineer determines it is practicable. As described in Park City's application for an MMPA ITA, there are two scenarios, approaching pile refusal and pile instability, where this imminent risk could be a factor; however, Park City describes a low likelihood of occurrence for the pile refusal/stuck pile or pile instability scenario as explained below.

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. This risk comes from the instability of a pile that has not reached a penetration depth where the pile would be considered stable. The pile could then fall and damage the vessel and/or personnel on board the vessel. This risk is minimized as 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. The lessee 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 3.21. 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 modified by NMFS OPR in December 2023, and the zones for sea turtles reflect the zone sizes proposed by BOEM during the consultation period (these are different than the zone sizes identified in the BA). 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)
Pile Driving – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 2,100 m monopile; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM
Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	3,300 m (visual or PAM detection)	2,700 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)
Jacket Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 3,400 m jacket foundations; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (3.4 km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM	At any distance (Minimum visibility zone (3.4km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM
Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	4,900 m (visual or PAM detection)	4,100 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)

UXO Detonations – Entirety of clearance zone must be visible; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance observable by the visual PSOs on all PSO platforms; At any distance within the 12 km zone monitored by PAM	***N/A***
Blue, Fin, sei whale (visual and PAM monitoring)	2,500-10,000 m*	***N/A***
Sperm whale	500-2,000 m*	***N/A***
Sea Turtles	500 m	***N/A***

*The clearance zones, which are visually and acoustically monitored, for UXO/MEC detonations were derived based on an approximate proportion of the size of the Level B harassment (TTS) isopleth. The clearance zone sizes are contingent on Park City Wind being able to demonstrate that they can identify charge weights in the field; if they cannot identify the charge weight sizes in the field then PCW would need to assume the E12 charge weight size for all detonations and must implement the E12 clearance zone.

3.9 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 US EEZ along the Atlantic coast; this includes the vessel transit routes between the WDA and ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. As explained below, it does not include a portion of the vessel transit routes between the WDA and ports in Canada or Europe outside the US EEZ as we have determined that the effects of vessel transit from those ports are not effects of the proposed action as defined in 50 CFR 402.17.

In the BA (Table 1-10), BOEM identifies the potential for up to 1,020 vessel round trips associated with the proposed project to originate from ports in Canada or Europe (400 round trips to unidentified ports in Europe and 620 round trips distributed between Halifax, NS, Sheet Harbor, NS, and Saint John, NB). These trips will occur at some time during the construction timeline split into two phases, for an average of approximately 250 trips per year. The ports that these vessels will originate from in Canada or Europe and the vessel routes from those port facilities to the project site are unknown and will be variable and depend, on a trip-by-trip basis, on weather and sea-state conditions, other vessel traffic, and any maritime hazards. These vessels are expected to enter the U.S. EEZ along the Atlantic Coast and then travel along established traffic lanes and fairways until they approach the lease area. Because the ports of origin and vessel transit routes are unknown, we are not able to identify what areas outside the U.S, EEZ will be affected directly or indirectly by the Federal action; that is, while we recognize that there will be vessel trips outside of the U.S. EEZ that would not occur but for the approval of the New England Wind COP, we cannot identify what areas vessel transits will occur as a result of BOEM's proposed approval of New England Wind's COP. Though these vessel transits may be caused by the proposed action, without specific information including vessel types and size, the ports of origin, and, the location, timing and routes of vessel transit, we cannot predict that specific consequences of these activities on listed species[9] are reasonably certain to occur, and they are therefore not considered effects of the proposed action. 50 CFR 402.17(a)-(b). Therefore, the action area is limited to the U.S. EEZ off the Atlantic coast of the United States extending from Cape Henlopen, NJ (the southern entrance of Delaware Bay) north to the Maine/Canada border.

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 the Cape Verde/Northwest Africa DPS of humpback whales, hawksbill sea turtles, shortnose sturgeon, the Gulf of Maine DPS of Atlantic salmon, giant manta rays, Eastern Atlantic DPS scalloped hammerhead sharks, and oceanic whitetip sharks and critical habitat designated for North Atlantic right whales or the New York Bight DPS of Atlantic sturgeon. The Cape Verde/Northwest Africa DPS of humpback whales does not occur in the action area; therefore, the proposed action will have no effect on this DPS. There are no ESA listed DPSs of humpback whales that occur in the action area. Similarly, the Eastern Atlantic DPS of scalloped hammerhead sharks does not occur in the area and there are no ESA listed hammerhead sharks in the action area; therefore, the proposed action will have no effect on any ESA listed hammerhead sharks. 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. We concur with BOEM's determination that the proposed action is not likely to adversely affect hawksbill sea turtles, giant manta rays, oceanic whitetip sharks, or critical habitat designated for the New York Bight DPS of Atlantic sturgeon; we conclude consultation informally for these species and critical habitat designations. Effects to shortnose sturgeon are addressed in section 6 and 7 of this opinion.

[9] In an abundance of caution, we have considered the risk that these vessel trips may pose to ESA listed species that may occur outside the US EEZ. We have determined that these species fall into two categories: (1) species that are not known to be vulnerable to vessel strike and therefore, we would not expect a project vessel to strike an individual regardless of the location of the vessel; or (2) species that may generally be vulnerable to vessel strike but outside the US EEZ, co-occurrence of project vessels and individuals of those ESA listed species are expected to be extremely unlikely due to the seasonal distribution and dispersed nature of individuals in the open ocean, and intermittent presence of project vessels. These factors make it extremely unlikely that there would be any effects to ESA listed species from the operation of project vessels outside the EEZ.

4.1 ESA Listed Species

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 WDA or where surveys will occur. While in the U.S. EEZ, vessels transiting to/from Canada could overlap with the marine distribution of Atlantic salmon. However, even if migrating salmon occurred along the routes of these vessels, we do not anticipate any effects to Atlantic salmon. There is no evidence of interactions between vessels and Atlantic salmon and we do not anticipate any effects from exposure to vessel noise. Vessel strikes are not identified as a threat in the listing determination (74 FR 29344) or the recent recovery plan (NMFS and USFWS 2019). We have no information to suggest that vessels in the ocean have any effects on migrating Atlantic salmon, and we do not expect there would be any due to Atlantic salmon migrating at depths below the draft of project vessels. Therefore, we do not expect any effects to Atlantic salmon even if migrating individuals co-occur with project vessels moving between the project site and ports in Canada. The proposed action will have no effect on the Gulf of Maine DPS of Atlantic salmon.

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 WDA and the area where survey activities will occur is outside of the deep offshore areas where Oceanic whitetip sharks occur. The only portion of the action area that overlaps with their distribution is the open ocean waters of the U.S. EEZ that may be transited by vessels traveling to/from Europe. 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.

Giant Manta Ray (Mobula 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. 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. 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 ft (200 to 400 m) (NMFS 2019a); the only portion of the action area with these depths is along the vessel transit routes south and east of the WDA. Based on the documented distribution of the species, Giant manta rays are not anticipated to occur in the WDA, in areas where surveys will occur, or along any of the vessel transit routes. As the presence of giant manta rays in the action area is extremely unlikely to occur, exposure to any project vessels is also extremely unlikely to occur. As such, effects are discountable; no take is anticipated and 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).

Given their rarity in waters north of Florida, hawksbill sea turtles are not expected to occur in the WDA or in the action area as a whole. Given that the presence of hawksbill turtles in the action area would be unanticipated and outside their normal range, 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 and discountable. No take is anticipated. Hawksbill turtles are not likely to be adversely affected by the proposed action.

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). Some vessels traveling from ports in Massachusetts (Salem) and/or Canada may transit through portions of Unit 1 while within the U.S. EEZ. No other effects of the project will extend to Unit 1. The action area does not overlap with Unit 2.

Consideration of Potential Effects to 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. Outside of potential vessel transits, there are no project activities that overlap with Unit 1. Vessel transits that may occur within Unit 1 will have no effect on any of the physical or biological features of critical habitat. Here, we explain our consideration of whether any project activities located outside of Unit 1 may affect Unit 1.

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, including those of vessels going to/from Canada, 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 New England Wind project would extend to Unit 1. The New England Wind 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 New England Wind 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.

Summary of Effects to Right Whale 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 North Atlantic right whales.

Critical Habitat Designated for the New York Bight DPS of Atlantic sturgeon

Critical habitat has been designated for all five DPSs of Atlantic sturgeon (82 FR 39160; effective date September 18, 2017). The action area overlaps with a portion of the Hudson River and Delaware River critical habitat units designated for the New York Bight DPS. The only project activity that may affect the Delaware River critical habitat unit is the transit of project vessels to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately river km 139). The only project activity that may affect the Hudson River critical habitat unit is the transit of project vessels to or from port facilities in Albany and/or Coeymans (approximately river km 203 and 185, respectively).

Hudson River Unit

The critical habitat designation for the New York Bight DPS is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The Hudson River critical habitat unit extends from the Federal Dam at Troy at approximately RKM 241 (RM 150) downstream to where the main stem river discharges at its mouth into New York City Harbor. In order to determine if the proposed action may affect critical habitat, we consider whether it would impact the habitat in a way that would affect its ability to support reproduction and recruitment. Specifically, we consider the effects of the action on the physical features of the critical habitat. The essential features identified in the final rule 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).

Feature One: Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages

During average fresh water flow, the freshwater portion of the Hudson River (where salinity is within the 0.0-0.5 ppt range) extends upstream from approximately West Point RKM 80 (RM 50). During conditions of high fresh water runoff (usually in the spring), salt water intrusion can be pushed south, meaning that the freshwater reach would begin at RKM 24 (RM 15). However, those conditions are intermittent and it is the reach upstream of RKM 80 (RM 50) that typically is within the 0.0 – 0.5 ppt range. Atlantic sturgeon in the Hudson River range as far upstream as the Federal Dam at Troy RKM 241 (RM 150) meaning that Atlantic sturgeon have access to approximately 100 miles of freshwater. A number of mapping products for the Hudson River are available, with various levels of detail on bottom characteristics (see for example NYDEC's benthic mapper[10] and products from the Lamont Doherty Lab[11]). While the area just below the Troy Dam has a gravelly bottom, the rest of the freshwater reach is dominated by mud and a

[10] https://www.dec.ny.gov/pubs/42937.html

[11] https://www.ldeo.columbia.edu/edu/k12/snapshotday/Mapping.html

sand-mud mix. Hard bottom substrate for spawning is known to occur near RKM 134 (RM 83; Hyde Park) and RKM 112 (RM 70) (Bain et al. 2000). While there are over 100 miles of freshwater in the Hudson River critical habitat unit, the presence of PBF 1 is limited to the patchy areas where hard bottom substrate is present.

The vessel transit routes between the New England WDA and ports in Coeymans Albany overlap with the portion of the Hudson River that contains PBF 1. However, project vessels will have no effect on this feature. This is because the project vessels will have no effect on salinity and will not interact with the bottom in this reach and therefore, there would be no impact to hard bottom habitat. The vessels will be loaded or unloaded at Coeymans or Albany by tying up at an existing berth and is not expected to set an anchor. Vessels will operate in the channel where there is adequate water depth to prevent bottoming out or otherwise scouring the riverbed. Vessel operations are not expected to affect the behavior of Atlantic sturgeon and therefore would not affect access to areas where PBF 1 are present. The vessels' operations will not preclude or delay the development of hard bottom habitat in the part of the river with salinity less than 0.5 ppt because it will not impact the river bottom in any way or change the salinity of portions of the river where hard bottom is found. Based on these considerations, the project will have no effect on PBF 1; that is, there will be no effect on how the PBF supports the conservation needs of Atlantic sturgeon in the action area.

Feature Two: 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

In considering effects to PBF 2, we consider whether the proposed action will have any effect on areas of soft substrate within transitional salinity zones between the river mouth and spawning sites for juvenile foraging and physiological development; therefore, we consider effects of the action on soft substrate and salinity and any change in the value of this feature in the action area. The Hudson River Estuary is tidally influenced from the Battery to the federal dam at Troy; during average fresh water flow, salt water intrusion reaches West Point, about 50 miles from the Battery. During conditions of high fresh water runoff (usually in the spring), salt water intrusion can be pushed south, as far as 15 miles from the Battery. Salinity level varies throughout these areas seasonally and daily depending on tidal and fresh water inputs, with salinity generally increasing from West Point to the Battery. A number of mapping products for the Hudson River are available, with various levels of detail on bottom characteristics (see for example NYDEC's benthic mapper[12] and products from the Lamont Doherty Lab[13]). While the area just below the Troy Dam has a gravelly bottom, the rest of the freshwater reach is dominated by mud and a sand-mud mix. The area between rkm 138 and rkm 43 is described as being largely silt (Coch and Bokuniewicz 1986). Simpson et al. (1986) examined benthic invertebrates at 16 stations in the lower Hudson River. Areas with relatively heterogeneous substrates (sands mixed with silts) contained the richest fauna in terms of abundance and variety. Fine, well-sorted sand had the lowest biomass and least variety. This study indicates that areas with fine sand may not support juvenile foraging as well as sandy-silt areas because they are not likely to have as high biomass or richness of benthic invertebrate resources. Haley et al. (1996) examined juvenile sturgeon use

[12] https://www.dec.ny.gov/pubs/42937.html

[13] https://www.ldeo.columbia.edu/edu/k12/snapshotday/Mapping.html

in the Hudson River and did not find a statistical difference in distribution based on substrate type; in this study, 80% of the stations sampled had silty substrate, 17.4% had sandy substrate and 2.3% had gravel substrate.

Project vessels will have no effect on this feature as they will not have any effect on salinity, and they will not interact with the river bottom in this reach of the river.

Feature Three: Water absent physical barriers to passage between the river mouth and spawning sites
In considering effects to PBF 3, we consider whether the proposed action will have any effect on 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: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow, given water that is too shallow can be a barrier to sturgeon movements, and an alteration in water flow could similarly impact the movements of sturgeon in the river, particularly early life stages that are dependent on downstream drift. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon.

Water of appropriate depth and absent physical barriers to passage 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, is present throughout the extent of critical habitat designated in the Hudson River. Water depths in the main river channels is also 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.

Vessels transiting to or from the New England Wind project site to Coeymans and/or Albany will travel through the portion of the Hudson River critical habitat unit containing PBF 3. Project vessels will have no effect on this feature as they will not have any effect on water depth or water flow and will not be physical barriers to passage for any life stage of Atlantic sturgeon that may occur in this portion of the action area. Therefore, there will be no effect on PBF 3.

Feature Four: Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function
In considering effects to PBF 4, we consider whether the proposed action will have any effect on 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: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we consider effects of the action on temperature, salinity and dissolved oxygen needs for Atlantic sturgeon spawning and

recruitment. These water quality conditions are interactive and both temperature and salinity influence the dissolved oxygen saturation for a particular area. We also consider whether the action will have effects to access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

Vessels transiting to or from the New England Wind project site to Coeymans and/or Albany will travel through the portion of the Hudson River critical habitat unit containing PBF 4. Project vessels will have no effect on this feature as they will not have any effect on temperature, salinity or dissolved oxygen.

Delaware River Unit

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 (RM 132.5), downstream to where the main stem river discharges into Delaware Bay at approximately RKM 78 (RM 48.5).

The Biological Opinion prepared by NMFS for the Paulsboro Marine Terminal considered effects of construction of the port facility and the effects of all vessels transiting between the mouth of Delaware Bay and the port on critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the November 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. Based on the available information, we expect that New England Wind vessels are similar to the vessels considered 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 affect critical habitat. We have determined that because the number of trips and vessel types are consistent with the activities described in the Paulsboro 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 New England Wind project. We have not identified any effects of the New England Wind project on critical habitat designated for the New York Bight DPS of Atlantic sturgeon that are beyond what was considered in the Paulsboro consultation; therefore, New England Wind vessels are not likely to adversely affect that critical habitat.

Summary of Effects to Atlantic Sturgeon (New York Bight DPS) Critical Habitat

We have determined that the proposed action will have no effect on the Hudson River critical habitat unit and is not likely to adversely affect the Delaware River critical habitat unit. Based on this conclusion and its supporting rationale, the action is not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon.

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

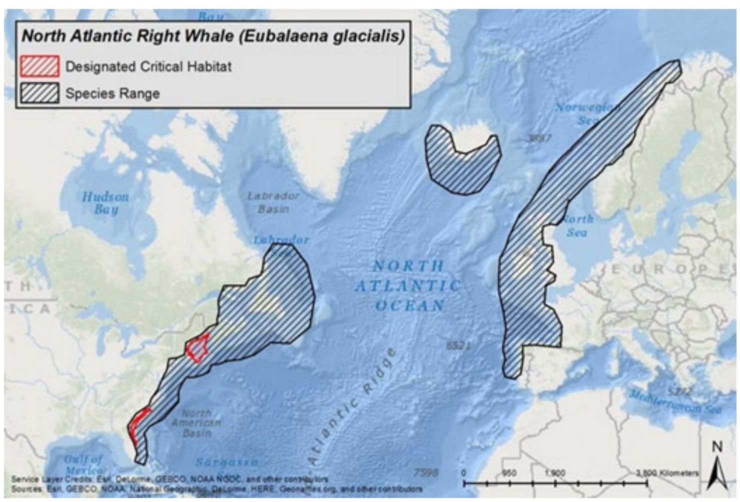
5.1 Marine Mammals

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 report (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 18^{th}

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[14] 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

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

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. Through February 10, 2024, 17 mother-calf pairs have been sighted in the 2023-2024 calving season; of these, 3 are thought to be first time mothers. One calf (mother Juno) has been sighted with injuries consistent with a vessel strike; while there are signs that the injuries are healing it is unclear if they will prove to be fatal and the calf is cataloged as a “serious injury.” Additionally, two other calves are considered “missing” and are likely mortalities as the mothers have been seen alone after only a single sighting with their calves.

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.[15] 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),

[15] 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).

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 February 10, 2024, there are 36 confirmed mortalities for the UME (including a juvenile female stranded on Martha's Vineyard in January 2024; while cause of death is pending the animal was previously observed with an entanglement, no evidence of vessel strike has been reported), 34 serious injuries (including the calf of #1612 observed in January 2024 with vessel strike 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-mortality-events). Mortalities are recorded as vessel strike (12), entanglement (9), perinatal (2), unknown/undetermined (3), examined (10), and pending (1; the January 24 female noted above).[16]

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[17].

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,

[16] https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2024 -north-atlantic-right-whale-unusual-mortality-event; last accessed February 10, 2024

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

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 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 7.7 right whales per year from 2015 through 2019 (Hayes et al. 2022). Using the refined methods of Pace et al. (2021), the estimated annual rate of total mortality for the period 2014–2018 was 27.4, which is 3.4 times larger than the 8.15 total derived from reported mortality and serious injury for the same period (Hayes et al. 2022). The 2023 SAR reports the observed human-caused mortality and serious injury was 8.1 right whales per year from 2016 through 2020 (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, which is 4.1 times larger than the 7.7 total derived from reported mortality and serious injury for the same period. 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).

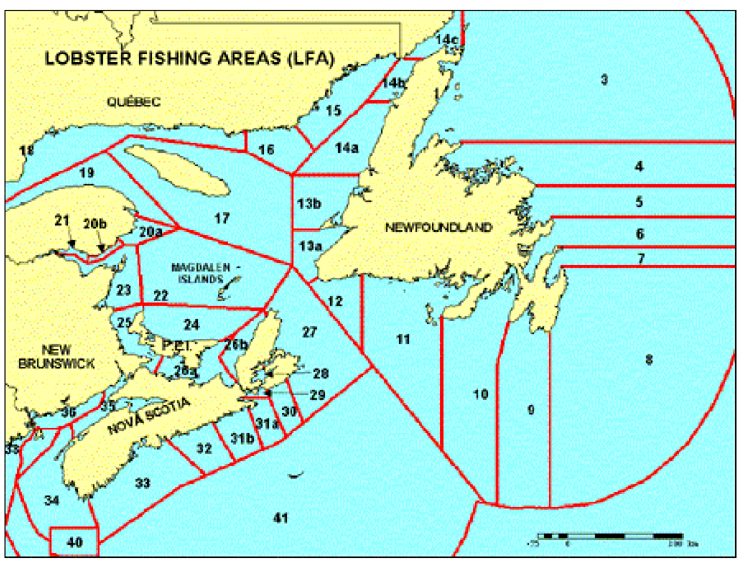
North Atlantic right whales have died or been seriously injured in Canadian waters by vessel strikes and entanglement in fishing gear (DFO 2014). Serious injury and mortality events are rarely observed where the initial entanglement occurs. After an event, live whales or carcasses may travel hundreds 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.[18] 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 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

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

issued annually[19]. 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 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

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

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 review 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)

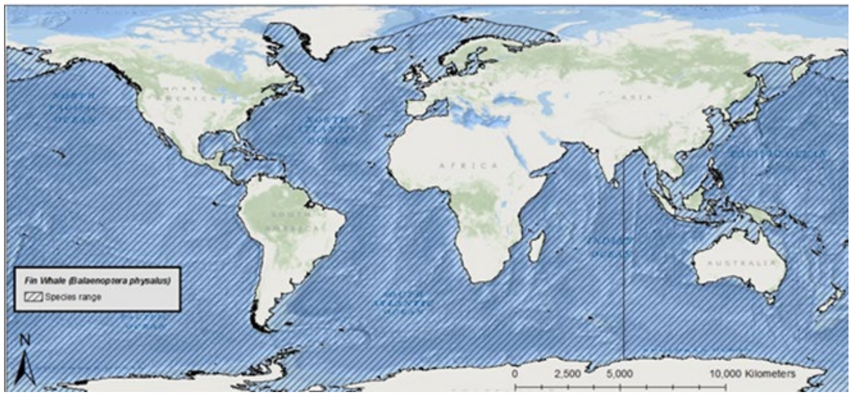
Globally there is one species of fin whale, *Balaenoptera physalus*. Fin whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010a) (Figure 5.1.3). Within this range, three subspecies of fin whales are recognized: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* 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).

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.

Figure 5.1.3. Range of the fin whale



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).[20] 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.

[20] 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).

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:

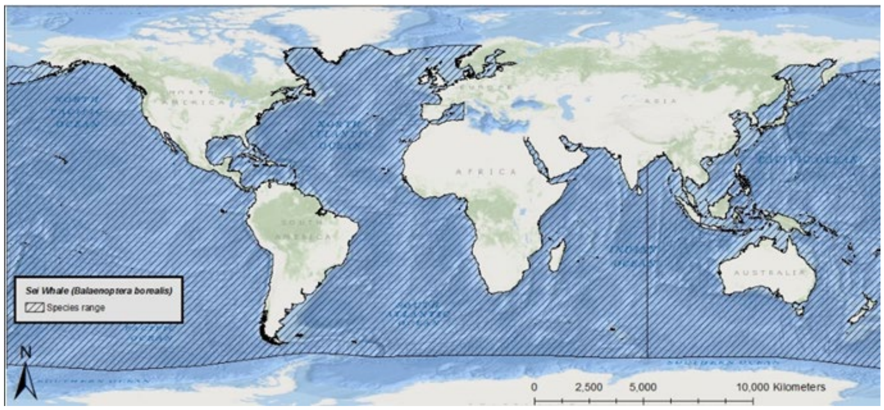
1. Coordinate state, federal, and international actions to implement recovery actions and maintain international regulation of whaling for fin whales;
2. Determine population discreteness and population structure of fin whales;
3. Develop and apply methods to estimate population size and monitor trends 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°), 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

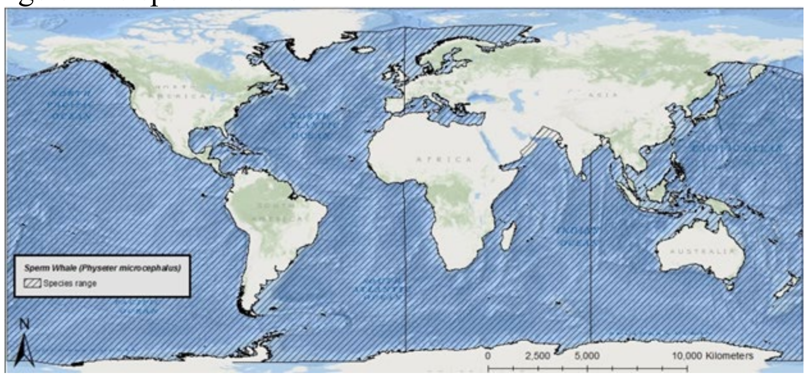
No critical habitat has been designated for the sei whale.

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[21], 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 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.

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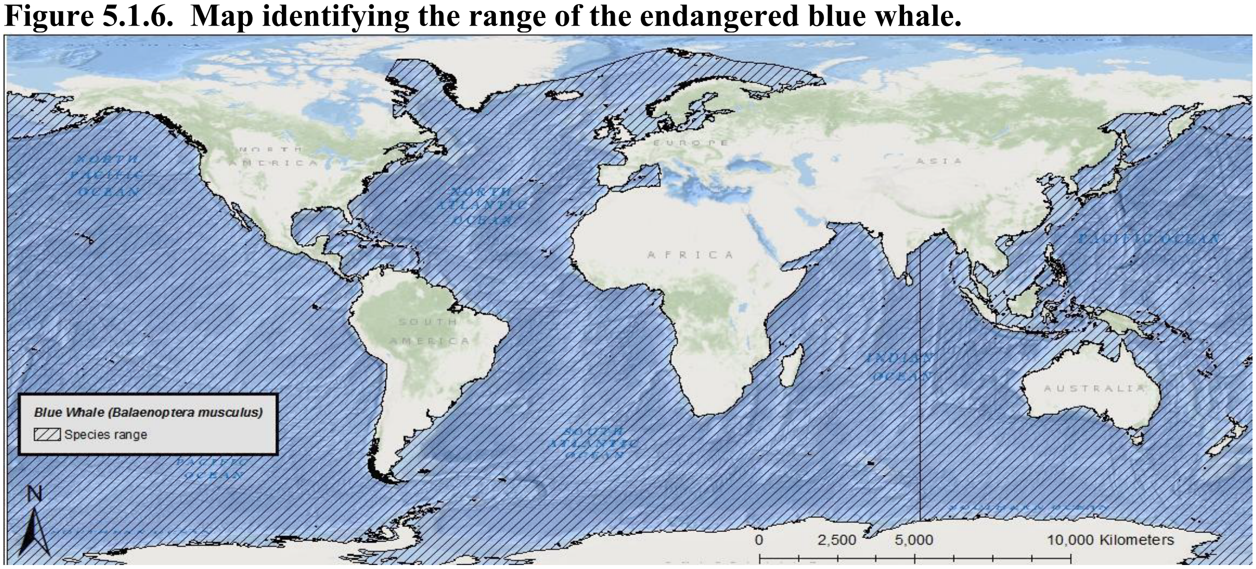
[21] Allee effects are broadly characterized as a decline in individual fitness in populations with a small size or density.

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.

5.1.5 Blue Whale (Balaenoptera musculus)
Blue whales are the largest animal on earth and distinguishable from other whales by a long-body and comparatively slender shape, a broad, flat "rostrum" when viewed from above, proportionally smaller dorsal fin, and are a mottled gray color that appears light blue when seen through the water (Figure 2). Most experts recognize at least three subspecies of blue whale, *B. m. musculus*, which occurs in the Northern Hemisphere, *B. m. intermedia*, which occurs in the Southern Ocean, and *B. m. brevicauda*, a pygmy species found in the Indian Ocean and South Pacific. The blue whale was listed as a single endangered species throughout its range on December 2, 1970 (35 FR 18319).

Figure 5.1.6. Map identifying the range of the endangered blue whale.



Information available from the recovery plan (NMFS 2020a), recent stock assessment reports (Caretta et al. 2022, Hayes et al. 2020, Muto et al. 2019), and status review (NMFS 2020b) were used to summarize the life history, population dynamics and status of the species as follows.
Life History
The average life span of blue whales is eighty to ninety years. They have a gestation period of ten to twelve months, and calves nurse for six to seven months. Blue whales reach sexual maturity between five and fifteen years of age with an average calving interval of two to three

years. They winter at low latitudes, where they mate, calve and nurse, and summer at high latitudes, where they feed. Blue whales forage almost exclusively on krill and can eat approximately 3,600 kilograms daily. Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90 to 120 m.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the blue whale.

The global, pre-exploitation estimate for blue whales is approximately 181,200 (IWC 2007). Current estimates indicate approximately 5,000 to 12,000 blue whales globally (IWC 2007). Blue whales are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. There are three stocks of blue whales designated in U.S. waters: the eastern North Pacific (current best estimate $N = 1,647$ $N_{min} = 1,551$; (Calambokidis and Barlow 2013)) central North Pacific ($N = 81$ $N_{min} = 38$), and western North Atlantic ($N = 400$ to 600 $N_{min} = 440$). The Southern Hemisphere ocean basins have approximately 2,000 individual blue whales.

Current estimates indicate a growth rate of just under three percent per year for the eastern North Pacific stock (Calambokidis et al. 2009). An overall population growth rate for the species or growth rates for the two other individual U.S. stocks are not available at this time.

Little genetic data exist on blue whales globally. Data from Australia indicates that at least populations in this region experienced a recent genetic bottleneck, likely the result of commercial whaling, although genetic diversity levels appear to be similar to other, non-threatened mammal species (Attard et al. 2010). Consistent with this, data from Antarctica also demonstrate this bottleneck but high haplotype diversity, which may be a consequence of the recent timing of the bottleneck and blue whales long lifespan (Sremba et al. 2012). Data on genetic diversity of blue whales in the Northern Hemisphere are currently unavailable. However, genetic diversity information for similar cetacean population sizes can be applied. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population of 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (<100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density.

In general, distribution is driven largely by food requirements; blue whales are more likely to occur in waters with dense concentrations of their primary food source, krill. While they can be found in coastal waters, they are thought to prefer waters further offshore (Figure 1). In the North Atlantic Ocean, the blue whale range extends from the subtropics to the Greenland Sea. They are most frequently sighted in waters off eastern Canada with a majority of sightings taking place in the Gulf of St. Lawrence. In the North Pacific Ocean, blue whales range from Kamchatka to southern Japan in the west and from the Gulf of Alaska and California to Costa

Rica in the east. They primarily occur off the Aleutian Islands and the Bering Sea. In the northern Indian Ocean, there is a "resident" population of blue whales with sightings being reported from the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca. In the Southern Hemisphere, distributions of subspecies (*B. m. intermedia* and *B. m. brevicauda*) seem to be segregated. The subspecies *B. m. intermedia* occurs in relatively high latitudes south of the "Antarctic Convergence" (located between 48°S and 61°S latitude) and close to the ice edge. The subspecies *B. m. brevicauda* is typically distributed north of the Antarctic Convergence.

Status
The blue whale is endangered as a result of past commercial whaling. In the North Atlantic, at least 11,000 blue whales were taken from the late nineteenth to mid-twentieth centuries. In the North Pacific, at least 9,500 whales were killed between 1910 and 1965. Commercial whaling no longer occurs; potential threats to blue whales identified in the 2020 Recovery Plan include ship strikes, entanglement in fishing gear and marine debris, anthropogenic noise, and loss of prey base due to climate and ecosystem change (NMFS 2020). There are no recent confirmed records of anthropogenic mortality or serious injury to blue whales in the U.S. Atlantic EEZ or in Atlantic Canadian waters (Henry et al. 2020). The total level of human caused mortality and serious injury is unknown, but it is believed to be insignificant and approaching a zero mortality and serious injury rate (Hayes et al. 2020). Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, the species has not recovered to pre-exploitation levels.

The 2020 5-Year Review for Blue Whales states that there is insufficient data to undertake an assessment of the blue whale's current status on a global scale. As none of the recovery criteria outlined in the Revised Recovery Plan have been met and given the existing data gaps, the recommendation was for blue whales to remain classified as endangered.

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

Recovery Goals
The goal of the 2020 Revised Recovery Plan is to promote the recovery of blue whales to the point at which they can be removed from the List of Endangered and Threatened Wildlife and Plants under the provisions of the ESA. The intermediate goal is to reach a sufficient recovery status to reclassify the species from endangered to threatened. The two main objectives for blue whales are to 1) increase blue whale resiliency and ensure geographic and ecological representation by achieving sufficient and viable populations in all ocean basins and in each recognized subspecies, and 2) increase blue whale resiliency by managing or eliminating significant anthropogenic threats. The Recovery Plan includes recovery criteria that address minimum abundance in each of the nine management units (abundance of 500 or 2,000 whales depending on the unit); stable or increasing trend in each of the nine management units; and criteria related to threat identification and minimization (NMFS 2020). The Recovery Plan also includes delisting criteria that address abundance, trends, and threat minimization/elimination (NMFS 2020).

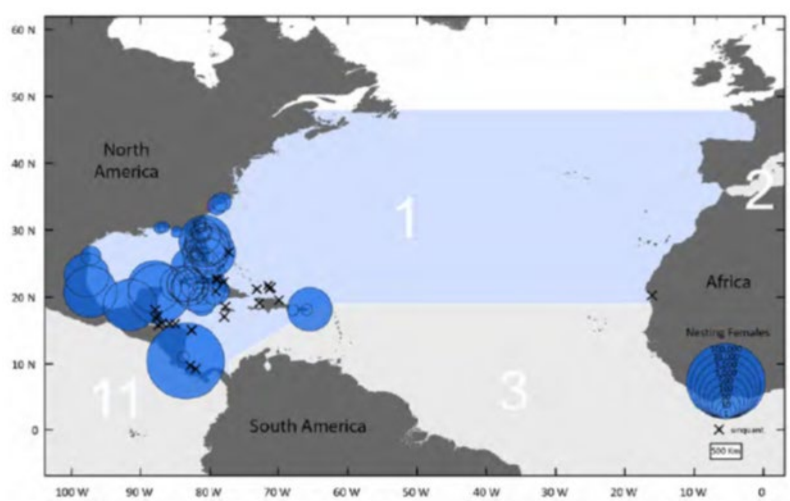
5.2 Sea Turtles

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).

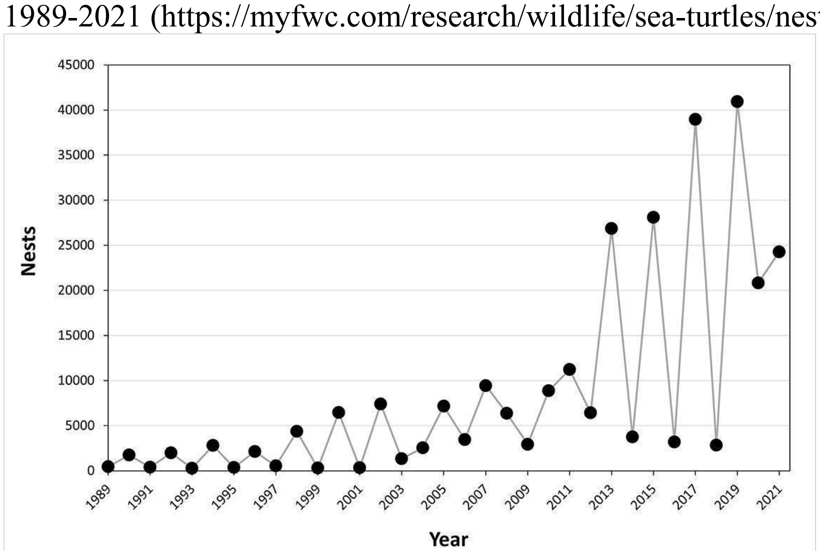
Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three nesting sites (using data through 2012), and available data indicated an increasing trend in nesting (Seminoff et al. 2015). Counts of nests and nesting females are 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.

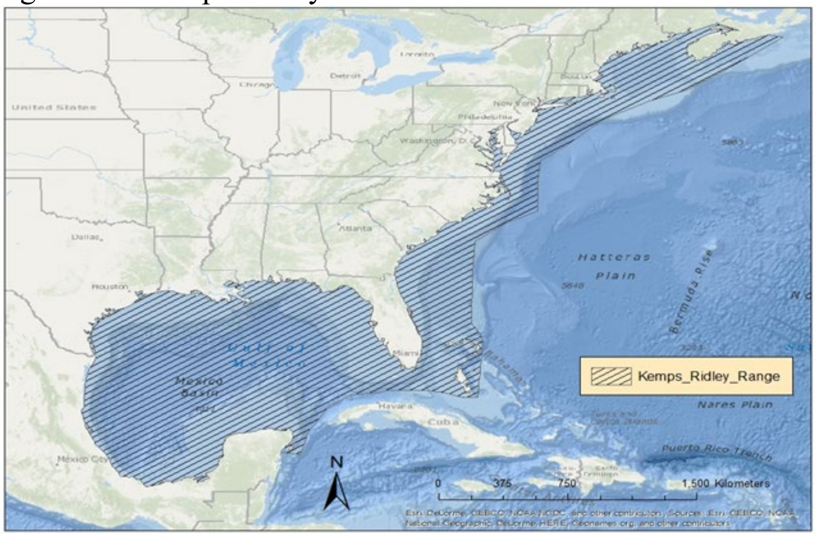
Priority actions to meet the recovery goals include:

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).

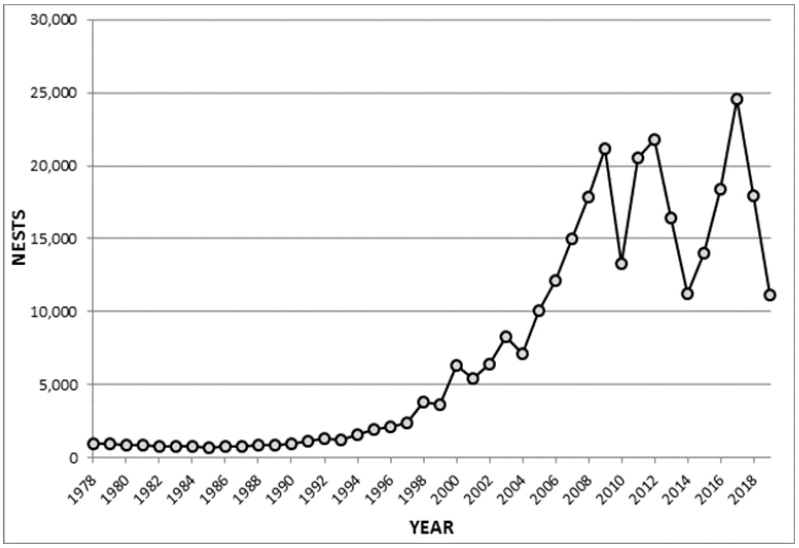
During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. The NEFSC caught a juvenile Kemp's ridley during 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.

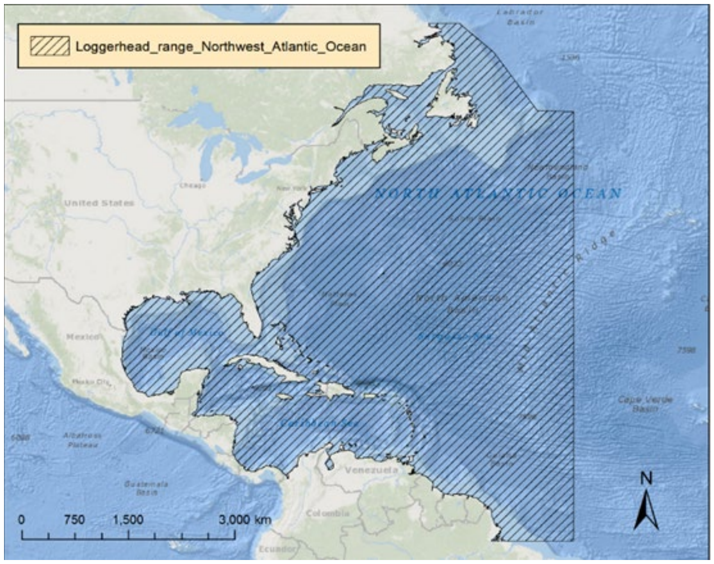
Recovery Goals
As with other recovery plans, the goal of the 2011 Kemp's ridley recovery plan (NMFS, USFWS, and SEMARNAT 2011) is to conserve and protect the species so that the listing is no longer necessary. The recovery criteria relate to the number of nesting females, hatchling recruitment, habitat 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/)

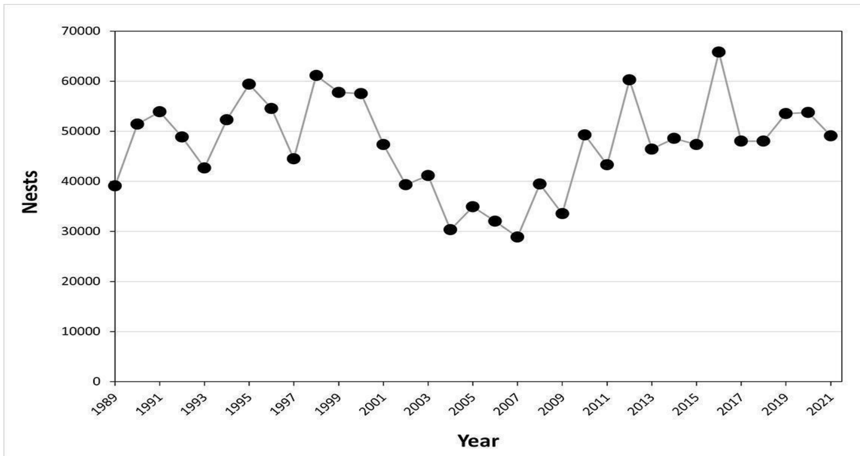
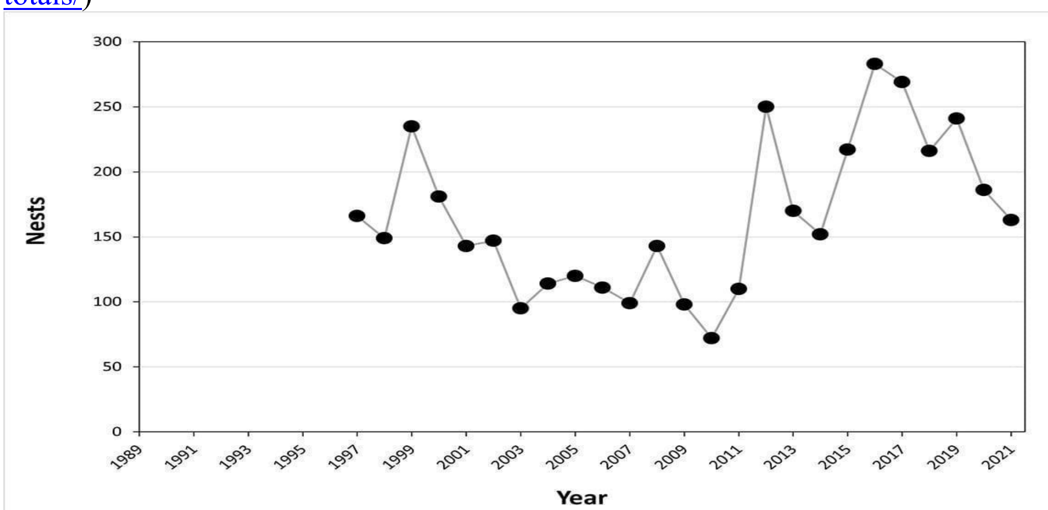


Figure 5.2.7. Annual nest counts of loggerhead sea turtles on index beaches in the Florida Panhandle, 1997-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)



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).

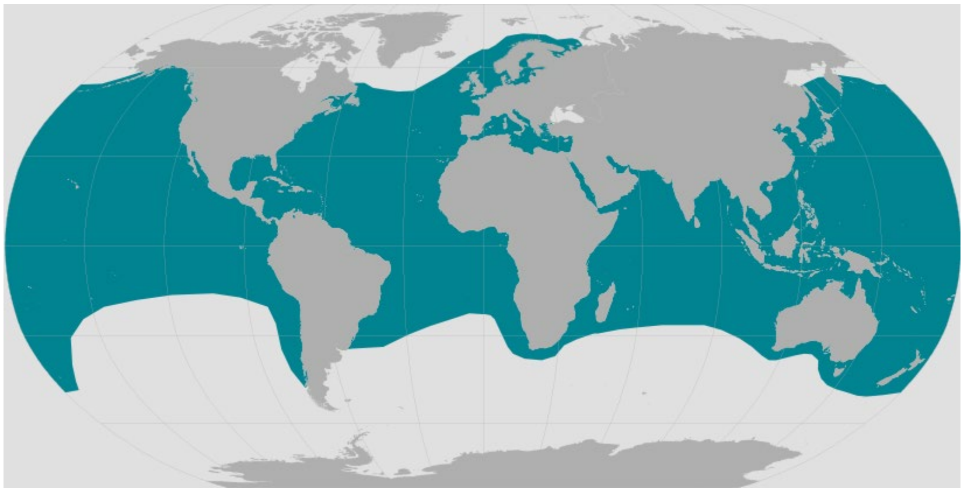
Recovery Goals
The recovery goal for the Northwest Atlantic loggerhead is to ensure that each recovery unit meets its recovery criteria, alleviating threats to the species so that protection under the ESA is not needed. The recovery criteria relate to the number of nests and nesting females, trends in 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)

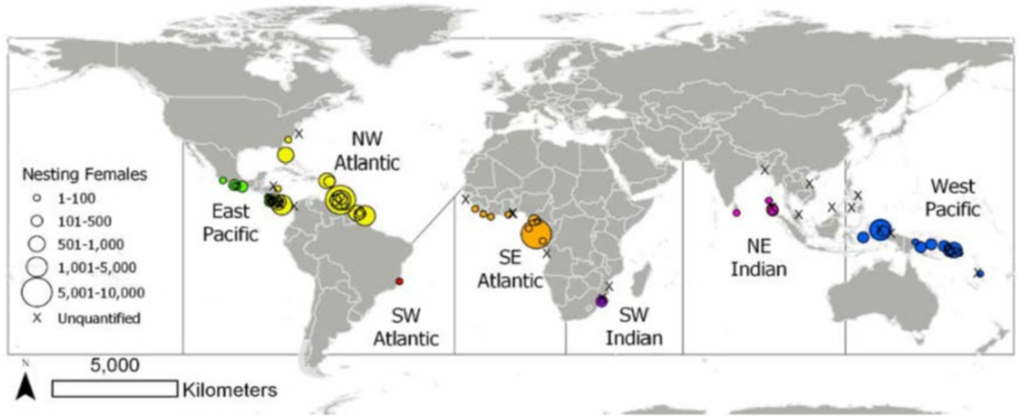
The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 5.2.8).

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).

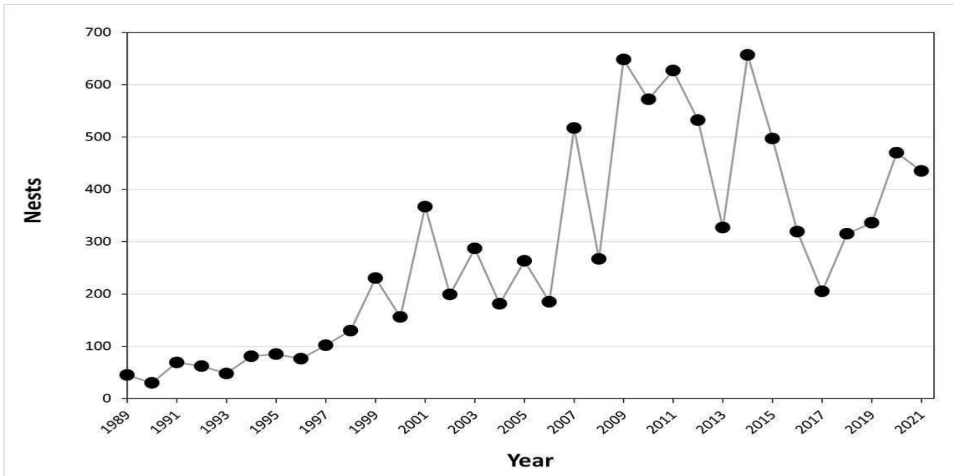
Several more recent assessments have been conducted. The Northwest Atlantic Leatherback Working Group was formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the NW Atlantic Ocean subpopulation 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:

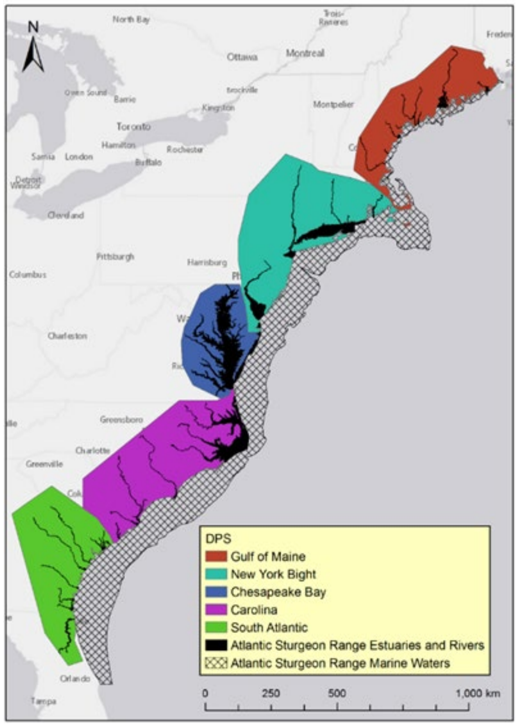
1. Protect and manage terrestrial and marine habitats.
2. Protect and manage the population.
3. Inform and educate the public.
4. Develop and implement international agreements.

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. 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. Effects to this designated critical habitat were considered in Section 4.0 of this Opinion.

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.[22] 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 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.

[22] 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).

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.
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.[23] 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

[23] 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.

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.

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; nearly all of the action area, inclusive of the New England Wind 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[24] 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,

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

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 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.

5.4 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[25]. 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

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[25] 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.

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 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.

Southeast Metapopulation

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 are not in the Environmental Baseline for the New England 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 one in line for 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 geographic extent of effects caused by project-related activities in those areas. The New England Wind WDA 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 New England 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 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). Due to these factors, the Northeast U.S. shelf area experiences one of the largest summer to winter temperature changes of any part of the ocean around the world. The result is a unique ocean feature called the Cold Pool, a band of cold bottom water that extends the length of the Mid-Atlantic Bight from spring through early fall. This temperature- salinity water mass occupies nearshore and offshore regions, including over Nantucket Shoals (east and southeast of Nantucket Island), creating a persistent frontal zone in the area (Kaplan 2011). Additionally, the region has seasonal upwelling and downwelling regimes, influenced by the edge of the continental shelf, which creates a shelf-break front. Marine vertebrates often use these oceanographic fronts for foraging and migration as they can aggregate prey (Scales et al. 2014). Offshore from Martha's Vineyard and Nantucket, shelf currents flow predominantly toward the southwest, beginning as water from the Gulf of Maine heading south veers around and over Nantucket Shoals. As the water transitions through Nantucket Sound, tidal water masses from nearshore mix with the shelf current, generally following depth contours offshore (Ullman and Cornellion 1999, BOEM 2020).

Water depths range from 43m-62m in the WDA (BOEM 2023); sea surface temperatures vary seasonally from approximately 41.7 °F (5.4 °C) in winter to 63.5 °F (17.5 °C) in summer (BOEM 2023). The seafloor in the WDA is predominantly composed of unconsolidated sediments ranging from silt and fine-grained sands to gravel. In general, finer substrates occur in low-current areas while coarser substrates occur in higher-current areas. The type of motion present in a high current area creates a dynamic habitat supporting mobile plants and animals that are accustomed to a certain degree of natural disturbance and are generally resilient to change. Coarser materials on the seafloor in these high current areas include gravel, cobble, and boulders. Conversely, the mobile sediment habitat is less conducive to species that live on, or are attached to, the seafloor making their occurrence in the action area uncommon. Finer sediments are usually found among discontinuous patches of sand. High current areas occur in regions such as the Muskeget Channel and OECC. This is supported by the site-specific benthic surveys which only identified hard bottom and complex habitat in the OECC with greatest abundance in the Muskeget Channel (BOEM 2023). Soft-bottom habitat was present within the entirety of the WFA and southern portions of the OECC, with substrate that is predominantly sand with some areas of mud. Eelgrass was identified in the OECC south of Cape Cod (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. 2022; 81 FR 4837).

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 locations 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. 2022, 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), and changing migration patterns (Gowan et al. 2019), as well as changing numbers in existing known high-use areas (Davis et al. 2017, 2020).

North Atlantic right whales feed on extremely dense patches of certain copepod species, primarily the late juvenile developmental stage of *C. finmarchicus*. These dense patches can be found throughout the water column depending on time of day and season. They are known to undergo daily vertical migration where they are found within the surface waters at night and at depth during daytime to avoid visual predators. North Atlantic right whales' diving behavior is strongly correlated to the vertical distribution of *C. finmarchicus*. Baumgartner et al. (2017) investigated North Atlantic right whale foraging ecology by tagging 55 whales in six regions of the Gulf of Maine and southwestern Scotian Shelf in late winter to late fall from 2000 to 2010. Results indicated that on average North Atlantic right whales spent 72 percent of their time in the upper 33 feet (10 meters) of water and 15 of 55 whales (27 percent) dove to within 16.5 feet (5 meters) of the seafloor, spending as much as 45 percent of the total tagged time at this depth.

The distribution of right whales is linked to the distribution of their principal zooplankton prey, calanoid copepods (Baumgartner and Mate 2005, NMFS 2005, Waring et al. 2012, Winn et al. 1986). New England waters are important feeding habitats for right whales (Hayes et al. 2020). Right whale calls have been detected by autonomous passive acoustic sensors deployed between 2005 and 2010 at three sites (Massachusetts Bay, Stellwagen Bank, and Jeffreys Ledge) in the southern Gulf of Maine (Morano et al. 2012, Mussoline et al. 2012). Comparisons between detections from passive acoustic recorders and observations from aerial surveys in Cape Cod Bay between 2001 and 2005 demonstrated that aerial surveys found whales on approximately two-thirds of the days during which acoustic monitoring detected whales (Clark et al. 2010).

Recent changes in right whale distribution (Kraus et al. 2016) are driven by warming of deep waters in the Gulf of Maine (Record et al. 2019). Prior to 2010, right whale movements followed the seasonal occurrence of the late stage, lipid-rich copepod *C. finmarchicus* from the western Gulf of Maine in winter and spring to the eastern Gulf of Maine and Scotian Shelf in the summer and autumn (Beardsley et al. 1996, Mayo and Marx 1990, Murison and Gaskin 1989, Pendleton et al. 2009, Pendleton et al. 2012). Recent surveys (2012 to 2015) have detected fewer individuals in the Great South Channel and the Bay of Fundy, and additional sighting records indicate that at least some right whales are shifting to other habitats, suggesting that existing habitat use patterns may be changing (Weinrich et al. 2000; Cole et al. 2007, 2013; Whitt et al. 2013; Khan et al. 2014). Warming in the Gulf of Maine has resulted in changes in the seasonal abundance of late-stage *C. finmarchicus*, with record high abundances in the western Gulf of Maine in spring and significantly lower abundances in the eastern Gulf of Maine in late summer and fall (Record et al. 2019). Baumgartner et al. (2017) discuss that ongoing and future environmental and ecosystem changes may displace *C. finmarchicus* from the Gulf of Maine and Scotian Shelf. The authors also suggest that North Atlantic right whales are dependent on the high lipid content of calanoid copepods from the Calanidae family (i.e., *C. finmarchicus, C. glacialis, C. hyperboreus*), and would not likely survive year-round only on the ingestion of small, less nutritious copepods in the area (i.e., *Pseudocalanus* spp., *Centropages* spp., *Acartia* spp., *Metridia* spp.). It is also possible that even if *C. finmarchicus* remained in the Gulf of Maine, changes to the water column structure from climate change may disrupt the mechanism that causes the very dense vertically compressed patches that North Atlantic right whales depend on (Baumgartner et al. 2017). One of the consequences of these environmental changes has been a shift of right whales out of habitats such as the Great South Channel and the Bay of Fundy, and into areas such as the Gulf of St. Lawrence in the summer and waters of southern New England primarily in the winter and spring, however, right whales have been observed there in all seasons. (NMFS NEFSC, unpublished data, Kraus et al. 2016b, Leiter et al. 2017, Stone et al. 2017, Quintana-Rizzo et al. 2021, Estabrook et al. 2022, O'Brien et al. 2022), with observations of foraging in both areas.

<u>North Atlantic right whale Presence in the New England Wind WDA and Surrounding Waters</u>

Right whale presence in the WDA is predominately seasonal; however, year-round occurrence in southern New England waters is documented, most notably around Nantucket Shoals (Leiter et al., 2017; O'Brien et al., 2022, Stone et al., 2017; Oleson et al., 2020, Quintana-Rizzo et al., 2021). Based on detections from aerial surveys and PAM deployments within the RI/MA WEA, right whales are expected in the WDA in higher numbers in winter and spring followed by decreasing abundance into summer and early fall. The WDA both spatially and temporally overlaps a portion of the migratory Biologically Important Area (BIA), which describes the area within which right whales migrate south to calving grounds generally in November and December, followed by a northward migration into feeding areas east and north of the WDA in March and April (LaBrecque et al., 2015; Van Parijs et al., 2015).

Since 2017, right whales have been sighted in the southern New England area nearly every month, with peak sighting rates between late winter and spring. Model outputs suggest that 23% of the right whale population is present from December through May, and the mean residence time has increased to an average of 13 days during these months (Quintana-Rizzo et al., 2021).

A hotspot analysis analyzing sighting data in southern New England from 2011-2019 indicated that right whale occurrence in the MA and MA/RI WEA was highest in the spring (March through May), and that few right whales were sighted in the area during that time frame in summer or winter (Quintana-Rizzo et al., 2021), a time when right whales distribution shifted to the east and south into other portions of the study area. In this analysis, “hotspots” were defined as season−period combinations with greater than 10 right whale sightings and clusters within a 90% confidence level). Density data from Roberts et al. (2022) confirm that the highest average density of right whales within a 6.2 km buffer of the WFA occurs from January to May, with the highest density in March (0.April whales/100km^2), which aligns with available sighting and acoustic data.

Quintana-Rizzo et al. (2021) examined aerial survey data collected between 2011−2015 and 2017−2019 to quantify right whale distribution, residency, demography, and movements in the RI/MA and MA WEAs, including the New England WFA. Considering the study area as a whole, the authors conclude that right whale occurrence increased during the study period with whales sighted in the area nearly every month since 2017; peak sighting rates were between December and May with mean residence time at 13 days. Age and sex ratios of the individuals present in the area are similar to those of the species as a whole, with adult males the most common demographic group. Reported behaviors include animals feeding and socializing. Areas of higher use within the study area varied between years and seasons, likely due to variable distribution of prey. The authors conclude that the mixture of movement patterns within the population and the geographical location of the study area suggests that the area could be a feeding location for whales that stay in the mid-Atlantic and north during the winter−spring months and a stopover site for whales migrating to and from the calving grounds. Estabrook et al. (2022) reviewed acoustic data from 2011-2015 focused on the RI/MA and MA WEA, which includes the New England Wind WFA; they found seasonal variations that were elevated from January to March and lowest during the summer months of July to September. Despite the seasonal variation in detections of right whale upcalls, detections occurred year-round.

The Right Whale Sighting Advisory System (RWSAS) alerts mariners to the presence of right whales, and collects sighting reports from a variety of sources including aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources (Coast Guard, commercial ships, fishing vessels, and the public). In 2016, North Atlantic right whales were observed in the shelf waters south of Martha’s Vineyard and Nantucket during January, February, and May. In 2017, North Atlantic right whales were observed in the shelf waters south of Martha’s Vineyard and Nantucket in every month except January, August, and December. In 2018 and 2019, North Atlantic right whales were observed in the shelf waters south of Martha’s Vineyard and Nantucket (i.e., the area between the islands and the Nantucket to Ambrose traffic lane) in every month except October; in 2020, right whales were detected in this area from January to March and July to December. No right whales were detected during aerial surveys of this area in June 2020, but right whales were observed in July, August, September, October, November, and December. Sightings data is not available for April and May 2020 as aerial survey operations were affected by pandemic restrictions (see https://whalemap.org/WhaleMap). In 2021, North Atlantic right whales were observed in the shelf waters south of Martha’s Vineyard and Nantucket in every month except for June. In 2022, North Atlantic right whales were detected (acoustic or visual) in the shelf waters south of Martha’s Vineyard and Nantucket, inshore of the

Nantucket to Ambrose traffic lanes, in every month except May and June; in 2023 there was at least one right whale detected in that area in every month except for July, September, October for the first half of 2023 (see https://whalemap.org/WhaleMap).

During aerial surveys conducted from 2011-2015 in the MA/RI WEA, including the WDA, the highest number of right whale sightings occurred in March (n=21), with sightings also occurring in December (n=4), January (n=7), February (n=14), and April (n=14), and no sightings in any other months (Kraus et al., 2016). There was not significant variability in sighting rate among years, indicating consistent annual seasonal use of the area by right whales. North Atlantic right whales were acoustically detected in 30 out of the 36 recorded months (Kraus et al., 2016). However, right whales exhibited strong seasonality in acoustic presence, with mean monthly acoustic presence highest in January (mean = 74%), February (mean = 86%), and March (mean = 97%), and the lowest in July (mean = 16%), August (mean = 2%), and September (mean = 12%). Aerial survey results indicate that North Atlantic right whales begin to arrive in the WDA in December and remain in the area through April. However, acoustic detections occurred during all months, with peak number of detections between December and late May (Kraus et al. 2016b; Leiter et al. 2017).

Kraus et al. (2016) observed that NARWs were most commonly present in and near the RI/MA WEA in the winter and spring and absent in the summer and fall. Quintana-Rizzo et al. (2018) observed similar occurrence patterns in the winter and spring but an increase in observations in the summer and fall. The change in seasonal occurrence between the 2011-2015 aerial surveys (Kraus et al. 2016) and the 2017 and 2018 (Quintana-Rizzo et al. 2018) aerial surveys is consistent with an increase trend in acoustic detections on the Mid-Atlantic OCS in the summer and autumn (Davis et al. 2017).[26] These data suggest an increasing likelihood of species presence from September through June. NARW SPUE in and near the RI/MA WEA by season in 2017 and 2018 is summarized in Figure 4 of the BA. Seasons are defined as winter = December, January, and February; Spring = March, April, and May; Summer = June, July, and August; and Autumn = September, October, and November. As described in the MMPA ITA Proposed Rule (88 FR 37606, June 8, 2023), the best available information regarding marine mammal densities in the action area is provided by habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory (Roberts *et al*., 2016, 2017, 2018, 2020). The updated models incorporate additional sighting data, including sightings from the NOAA Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys from 2010-2016 which included some aerial surveys over the RI/MA & MA WEAs (NEFSC & SEFSC, 2011a, 2011b, 2012, 2014a, 2014b, 2015, 2016). Roberts et al. (2020) further updated model results for North Atlantic right whales by incorporating additional sighting data and implementing three major changes: Increasing spatial resolution, generating monthly estimates on three time periods of survey data, and dividing the study area into five discrete regions.

As described in the BA and in the MMPA ITA Proposed Rule, the best available information regarding marine mammal densities in the portion of the action area encompassing the WDA is provided by habitat-based density models produced by the Duke University Marine Geospatial

[26] Based on frequency of acoustic detections of NARW in Davis et al. (2017) designated monitoring region 7: Southern New England and New York Bight. This monitoring region encompasses the lease area.

Ecology Laboratory (Roberts et al., 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 (see Tables 6-10 in JASCO, 2023). Table 6-1 below includes the mean monthly density estimates for right whales in a 50-km perimeter around the New England Wind WDA (see Table 7 in JASCO, 2023).

Table 6.1. Average Monthly Density Estimates for North Atlantic right whales within 50 km of the Lease Area Perimeter.

Species	Monthly Densities (animals per 100 km^2)											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
North Atlantic right whale	0.542	0.649	0.566	0.507	0.316	0.080	0.051	0.031	0.043	0.054	0.113	0.340

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, foraging in northern parts of the action area when copepod patches of sufficient density are present. Calving is not anticipated to occur in the action area.

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 along the Atlantic coast. 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). The breeding and calving areas used by this species are unknown (Hayes et al. 2021).

Sei whales occurring in the North Atlantic 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 New England Wind WDA.

Sei whales may be present in and around the WDA year-round but are most commonly present in the spring and early summer (Davis et al. 2020). Sightings data from 1981 to 2018, indicate that sei whales may occur in the area in relatively moderate numbers during the spring and in low numbers in the summer (North Atlantic Right Whale Consortium 2018). Kraus et al. (2016) and Quintana-Rizzo et al. (2018) report observed sei whales in and near the RI/MA WEA from March through June from 2011 through 2015 and in 2017, respectively, with the timing of peak occurrence varying by year. Sei whales were absent from the area from August through February. In the RI/MA WEA in 2017, sightings were generally concentrated to the south and east of the New England Wind WDA. This distribution suggests that sei whales are likely to occur in and near the lease area between March and June if recent patterns of habitat use continue. However, no sei whales were observed in the same study area in 2018 (Quintana-Rizzo et al. 2018). During 2020-2021 aerial surveys of the Massachusetts WEA, one sei whale was observed during the spring of 2021 in an area to the southeast of the New England Wind lease area (O'Brien et al. 2021). Kraus et al. (2016) observed an unusually large number of sei whales during aerial and acoustic surveys of the RI/MA WEA and vicinity that were conducted from 2011 through 2015. Several individuals were observed in the study area from March through June, with peaks in May and June, at a mean abundance ranging from zero to 26 animals (Stone et al. 2017). Quintana-Rizzo et al. (2019) observed a large concentration of sei whales in the area in April, May, and July of 2017 peaking at 29 individuals in May, but none were observed in 2018. O'Brien et al. (2020, 2021a, 2021b) observed several sei whales 40 miles or more to the southeast of the WDA in 2019 but none were observed in the study area in 2020.

As part of the application for an MMPA ITA for the New England Wind project, JASCO (2023) used data from Roberts et al. (2022) to calculate mean monthly density estimates in different portions of the action area where project noise will occur. In the area within 50 km of the lease area, monthly density of sei whales ranges from 0.009-0.121 sei whales/100 km^2, with the lowest densities from July to March and the highest in April-May.

In summary, we anticipate individual sei whales to occur in the action area year round, with presence in the nearer shore portions of the action area, including the lease and cable corridors, primarily in the spring and fall. The presence of sei whales along vessel transit routes south of the WDA is expected to be rare given the species offshore and more northerly distribution. We expect individuals in the action area to be making seasonal migrations, and to be foraging when krill are present. Foraging adult sei whales are most likely to occur in the WDA but the observation of three adult sei whales with calves in the MA and MA/RI WEA during spring and summer months (Kraus et al. 2016) indicates adult/calf pairs could occasionally be seasonally present in the WDA.

Sperm whale (Physeter macrocephalus)
In the action area, sperm whales may be present along the oceanic portions of all potential vessel transit routes and occasionally in the more offshore portion of the WDA. Sperm whales in the action area belong to the 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 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.

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).

Historical sightings data from 1979 to 2018 indicate that sperm whales may occur in and near the RI/MA WEA in the summer and autumn in relatively low to moderate numbers (North Atlantic Right Whale Consortium 2018). Kraus et al. (2016) recorded four sperm whale sightings in and near the RI/MA WEA between 2011 and 2015. Three of the four sightings occurred in August and September 2012, and one occurred in June 2015. Because of the limited sample size, Kraus et al. (2016) were not able to calculate SPUE or estimate abundance in the action area, and specific sighting locations were not provided. No adults were observed foraging or with calves during the 2011-2015 aerial surveys (Kraus et al. 2016).

As part of the application for an MMPA ITA for the New England Wind project, JASCO (2023) used data from Roberts et al. (2022) to calculate mean monthly density estimates in different parts of the action area that will experience project noise. In the area within 50-km of the New England Wind lease area, monthly density of sperm whales ranges from 0.004-0.111 sperm whales/100km^2, with the highest density in August.

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 through the MA/RI WEA 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 2015) well beyond that of the lease area, foraging is not expected to occur in the WDA. Additionally, sperm whales may occur along the oceanic portions of vessel transit routes south, north, and east of the WDA, with presence most likely in more offshore waters.

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 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 occurring in the North Atlantic belong to the western North Atlantic stock (Hayes et al. 2019). 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). 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 2010a). 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). However, neonate strandings along the U.S. Mid-Atlantic coast from October through January indicate a possible offshore calving area (Hain et al. 1992). 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).

Aerial survey observations collected by Kraus et al. (2016) from 2011 through 2015 and Quintana-Rizzo et al. (2018) in 2017 and 2018 indicate peak fin whale occurrence in the RI/MA WEA from May to August; however, the species may be present at varying densities during any month of the year. During seasonal aerial and acoustic surveys conducted from 2011-2015 in the MA/RI WEA, fin whales were observed every year, and sightings occurred in every season with the greatest numbers during the spring (n = 35) and summer (n = 49) months (Kraus et al., 2016). Observed behavior included feeding and migrating. Despite much lower sighting rates during the winter, a hydrophone array confirmed fin whales presence throughout the year (Kraus et al. 2016). LaBrecque et al. (2015) delineated a BIA for fin whale feeding in an area extending from Montauk Point, New York, to the open ocean south of Martha's Vineyard between the 49-foot (15-m) and 164-foot (50-m) depth contours. This BIA encompasses the New England Wind WFA, and is used extensively by feeding fin whales from March to October.

As part of the application for an MMPA ITA for the New England Wind project, JASCO (2023) used data from Roberts et al. (2022) to calculate mean monthly density estimates in portions of the action area where project noise will be experienced. In the area within 50 km of the lease area, monthly density of fin whales ranges from 0.059- 0.390 fin whales/100 km^2, with the lowest density in November and highest density in May-September. This is consistent with regional occurrence timing derived from regional PAM data, which indicate that this species is present and vocalizing in the region throughout the year, (Davis et al. 2020). However, while Davis et al. (2020) found the lowest likelihood of occurrence in May and June, Kraus et al. (2016) observed fewer individuals from September through March. As shown, fin whales are likely to be present in the WDA year round with seasonal variations, and fin whales are likely to have reduced density during the fall.

In summary, we anticipate individual fin whales to occur in the WDA year-round, with the highest numbers in the spring through early fall. 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 in the oceanic portions of the action area year round.

Western North Atlantic Stock of Blue whales (Balaenoptera musculus)
In the action area, blue whales are present along the oceanic portions of all potential vessel transit routes and are expected to occasionally occur in the more offshore portions of the WDA. Blue whale presence and behavior in the action area is best understood in the context of their range. 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 for blue whales), 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).

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). Davis et al. (2020) assessed PAM data on the Atlantic Coast between 2004-2010 and 2011-2014. Using PAM system deployed during 2011-2014, they detected blue whale calls off the coast of Massachusetts and Rhode Island, with seasonal variations. Blue whale vocalizations were detected in the winter months of November to February. There is some evidence of shifts in blue whale distribution, with a decrease in abundance on the Scotian shelf and southern New England mirroring shifts in prey distribution (Davis et al. 2020).

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), which is outside of the WDA. Based on the available information summarized above, we expect blue whales to be rare in the WDA with presence limited to transient individuals or small groups in the furthest offshore portion of the WDA. Based on the rarity of detections in nearshore waters, it is reasonable to expect that the presence of blue whales along vessel transit routes between the WDA and coastal ports in MA, CT, RI, NJ, and NY is rare.

In summary, individual blue whales are anticipated to occur infrequently in deeper, offshore waters of the action area, with a small number of individuals occurring in the furthest offshore portions of the WDA. These individuals are expected to be moving through and nearby the WDA as they make seasonal migrations, and to be foraging along the shelf break. The presence of blue whales along the vessel transit routes to and from coastal New England and Mid-Atlantic ports is expected to be rare, with presence more likely in areas of the U.S. EEZ further offshore transited by vessels moving between the WDA and more distant ports (i.e., Canada and Europe).

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 along the U.S. Atlantic Coast, including into southern New England waters that include the WDA and are expected to occur in the action area.

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 2011a, 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 (79 FR 39855). 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 (outside the action area) year round.

Regional historical sightings, strandings, and bycatch data indicate that loggerhead and leatherback turtles are relatively common in waters of southern New England, while Kemp's ridley turtles and green turtles are less common (Kenney and Vigness-Raposa 2010). Aerial surveys conducted seasonally, from 2011-2015, in the MA WEA recorded the highest abundance of endangered sea turtles during the summer and fall, with no significant inter-annual variability. For most species of sea turtles, relative density was even throughout the WEA. Sea turtles in the WDA are adults or juveniles; due to the distance from any nesting beaches, no hatchlings occur in the WDA. Similarly, no reproductive behavior is known or suspected to 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 2013 routinely documented leatherbacks in the MA/RI WEA and surrounding areas during summer months (NEFSC and SEFSC 2018, 2022: Palka 2021).

Satellite tagging studies have been used to understand leatherback sea turtle behavior and movement in portions of the action area (Dodge et al. 2014, Dodge et al. 2015, Eckert et al. 2006, James et al. 2005a, James et al. 2005b, James et al. 2006a). These studies show that leatherback sea turtles move throughout most of the North Atlantic from the equator to high latitudes. Key foraging destinations include, among others, the eastern coast of United States (Eckert et al. 2006). 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 to/from the South Atlantic.

Telemetry studies provide information on the use of the water column by leatherback sea turtles. Based on telemetry data for leatherbacks (n=15) off Cape Cod, Massachusetts, leatherback turtles spent over 60% of their time in the top 33 ft. (10 m) of the water column and over 70% in the top 49 ft. (15 m) (Dodge et al. 2014). Leatherbacks on the foraging grounds moved with slow, sinuous area-restricted search behaviors. Shorter, shallower dives were taken in productive, shallow waters with strong sea surface temperature gradients. They were highly aggregated in shelf and slope waters in the summer, early fall, and late spring. During the late fall, winter, and early spring, they were more widely dispersed in more southern waters and neritic habitats (Dodge et al. 2014). Leatherbacks (n=24) tagged in Canadian waters primarily used the upper 98 ft. (30 m) of the water column and had shallow dives (Wallace et al. 2015).

Leatherbacks tagged off Massachusetts showed a strong affinity to the northeast United States continental shelf before dispersing widely throughout the northwest Atlantic (Dodge et al. 2014). The tagged leatherbacks ranged widely between 39°W and 83°W, and between 9°N and 47°N, over six oceanographically distinct ecoregions defined by Longhurst: the Northwest Atlantic Shelves (n=20), the Gulf Stream (n=16), the North Atlantic Subtropical Gyral West (hereafter referred to as the Subtropical Atlantic, n=15), the North Atlantic Tropical Gyral (the Tropical Atlantic, n=15), the Caribbean (n=6) and the Guianas Coastal (n=7) (Dodge et al. 2014). This data indicates that leatherbacks are present throughout the action area considered here and may be present along the vessel transit routes from Canada and Europe. From the tagged turtles in this study, there was a strong seasonal component to habitat selection, with most leatherbacks remaining in temperate latitudes in the summer and early autumn and moving into subtropical and tropical habitat in the late autumn, winter, and spring. Leatherback turtles might initiate migration when the abundance of their prey declines (Sherrill-Mix et al. 2008).

Dodge et al. (2018) used an autonomous underwater vehicle (AUV) to remotely monitor fine-scale movements and behaviors of nine leatherbacks off Cape Cod, Massachusetts. The "TurtleCam" collected video of tagged leatherback sea turtles and simultaneously sampled the habitat (e.g., chlorophyll, temperature, salinity). Representative data from one turtle was reported in Dodge et al. (2018). During the 5.5 hours of tracking, the turtle dove continuously from the surface to the seafloor (0-66 ft. (0-20 m)). Over a two-hour period, the turtle spent 68% of its time diving, 16% swimming just above the seafloor, 15% at the surface, and 17% just below the surface. The animal frequently surfaced (>100 times in ~2 hours). The turtle used the entire water column, feeding on jellyfish from the seafloor to the surface. The turtle silhouetted prey 36% of the time, diving to near/at bottom, and looking up to locate prey. The authors note that silhouetting prey may increase entanglement in fixed gear if a buoy of float is mistaken for jellyfish (Dodge et al. 2018).

Leatherbacks were the most frequently sighted sea turtle species in monthly aerial surveys of the RI/MA WEA from October 2011 through June 2015 (Kraus et al. 2016). However, leatherback sea turtles showed an apparent preference for the northeastern corner of the WEA, which is consistent with results from a tagging study on leatherbacks in the area (Kraus et al. 2016, Dodge et al., 2014). These results suggest an important seasonal habitat for leatherbacks in southern New England (Kraus et al. 2016, Dodge et al. 2014) that overlaps with a portion of the action area but is outside the WDA. Kraus et al. (2016) recorded 153 observations (161 animals) in monthly aerial surveys, all between May and November, with a strong peak in the fall (see Table 4.7 in the BA). Data from Kraus et al. (2016) indicates that in some parts of the year, leatherbacks would be the most abundant sea turtle species in the WDA, which is consistent with the other information on sea turtle occurrence in the vicinity presented here. Leatherback sightings per unit effort (SPUE) in the RI/MA WEA and vicinity from 2020 to 2021 are displayed by season in Figure 3-6 of the BA (from O'Brien et al. 2022). As shown, the majority of observations were clustered to the east of the WDA and south of Nantucket with highest numbers in the fall months of October-December and one observation in July. The Sea Turtle Stranding and Salvage Network (STSSN) reported 89 offshore and 142 inshore leatherback sea turtle strandings between 2017 and 2021 from New York to Massachusetts (NMFS STSSN 2022).

There are limited density estimates for sea turtles in the WDA. As part of the acoustic impact analysis for this project, (COP Appendix III-M) sea turtle densities in the New England Wind WDA (plus a 10 km buffer) were calculated. More information on the data sources is presented in Section 7.1 of this Opinion. For leatherbacks, seasonal density ranges from 0.023 animal/100km^2 in the winter and spring to 0.873 animals/100km^2 in the fall.

Based on the information presented here, we anticipate leatherback sea turtles to occur in the WDA during the warmer months, typically between June and November. Leatherbacks are also expected along the vessel transit routes, with presence dependent on the season.

Northwest Atlantic DPS of Loggerhead sea turtles
The loggerhead 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.

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 action area (Winton et al. 2018). In southern New England, 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). Loggerheads are absent from southern New England during winter months (Kenney and Vigness-Raposa 2010; Shoop and Kenney 1992). Aerial surveys conducted over the Massachusetts WEA in 2020-2021, observed loggerhead sea turtles in the eastern portions of the WEA and Nantucket Shoals concentrated in the fall (O'Brien 2021, 2022).

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). 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).

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 (NEFSC and SEFSC 2011a). 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 2013 AMAPPS aerial surveys of the Atlantic continental shelf. Large concentrations were regularly observed in proximity to the RI/MA WEA (NEFSC and SEFSC 2018). Kraus et al. (2016) observed loggerhead sea turtles within the RI/MA WEA in the spring, summer, and autumn, with the greatest density of observations in August and September.

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).

There are limited density estimates for sea turtles in the WDA. As part of the acoustic impact analysis for this project, sea turtle densities for the New England Wind WDA plus a 10 km buffer were calculated (see Table 3-30 in BOEM's BA). More information on the data sources is presented in Section 7.1 of this Opinion. For loggerheads, seasonal density ranges from 0.108 animal/100km^2 in the winter and spring to 0.633 animals/100km^2 in the fall.

Based on the information presented here, we anticipate loggerheads from the Northwest Atlantic DPS to occur in the WDA (i.e., the WFA and cable corridors) during the warmer months, typically between June and November. Loggerheads are also expected along the vessel transit routes, with seasonal presence dependent on latitude.

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 from south Texas to north Florida 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. However, Kraus et al. (2016) recorded six observations in the RI/MA WEA over 4 years, all in August and September 2012. The sighting data were insufficient for calculating SPUE for this species (Kraus et al. 2016). Other aerial surveys efforts conducted in the region between 1998 and 2017 have observational records of species occurrence in the waters surrounding the RI/ME WEA during the autumn (September to November) at densities ranging from 10 to 40 individuals per 1,000 km (North Atlantic Right Whale Consortium 2018; NEFSC and SEFSC 2018). Juvenile Kemp's ridley sea turtles represented 66% of 293 cold-stunned turtle stranding records collected in inshore waters of Long Island Sound from 1981 to 1997 (Gerle et al. 1998) and represent the greatest number of sea turtle strandings in most years.

There are limited density estimates for sea turtles in the WDA. As part of the acoustic impact analysis for this project, sea turtle densities for the New England Wind WDA plus a 10 km buffer were evaluated (see Table 3-30 in BOEM's BA). More information on the data sources is presented in Section 7.1 of this Opinion. For Kemp's ridleys, seasonal density is estimated at 0.015 animal/100km^2 year round; however, presence from December – April is extremely unlikely due to low water temperatures in the WDA at that time of year.

Based on the information presented here, we anticipate Kemp's ridley sea turtles to occur in the WDA during the warmer months, typically between June and November. Kemp's ridleys are also expected along the vessel transit routes, with seasonal presence dependent on latitude.

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 in 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.

In addition to being seasonally present in the WDA, green sea turtles are likely to occur in portions of the vessel traffic component of the action area.

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). Kenney and Vigness-Raposa (2010) recorded one confirmed sighting within the RI/MA WEA in 2005. The Sea Turtle Stranding and Salvage Network (STSSN) reported one offshore and 20 inshore green sea turtle strandings between 2017 and 2019, and green sea turtles are found each year stranded on Cape Cod beaches (NMFS STSSN 2021; WBWS 2018). Five green turtle sightings were recorded off the Long Island shoreline 10 to 30 miles southwest of the RI/MA WEA in aerial surveys conducted from 2010-2013 (NEFSC and SEFSC 2018). However, given the relative abundance of observations farther to the south, adult green sea turtles are likely an infrequent visitor to the area. This conclusion is supported by the lack of green sea turtle observations recorded in an intensive aerial survey of the RI/MA WEA from October 2011 to June 2015 (Kraus et al. 2016). However, the aerial survey methods used in the region to date are unable to reliably detect juvenile turtles, sight several unidentified turtles, and do not cover the shallow nearshore habitats most commonly used by this species.

Juvenile green sea turtles represented 6% of 293 cold-stunned turtle stranding records collected in inshore waters of Long Island Sound from 1981 to 1997 (Gerle et al. 1998) and represent the lowest number of overall stranding between 1979 and 2016. These and other sources of information indicate that juvenile green turtles occur periodically in shallow nearshore waters of Long Island Sound and the coastal bays of New England (Morreale et al. 1992; Massachusetts Audubon 2012), but their presence offshore in the Lease Area is also possible.

There are limited density estimates for green sea turtles in the WDA. As part of the acoustic impact analysis for this project, sea turtle densities were evaluated for the New England Wind WDA plus a 10 km buffer. More information on the data sources is presented in Section 7.1 of this Opinion. Green sea turtles are rare in this area and there are no density data available for this species, so the Kemp's ridley sea turtle density is used as a surrogate; this is reasonable based on the known distribution of Green sea turtles in New England waters. As such, seasonal density ranges for green sea turtles are expected to be less than 0.019 animal/100km^2 year-round in the WDA, with no green sea turtles expected in the winter.

Based on the information presented here, we anticipate green sea turtles to occur in the WDA during the warmer months, typically between June and November. Green sea turtles are also expected along the vessel transit routes, with seasonal presence dependent on latitude.

6.3 Summary of Information on Listed Marine Fish 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 ports identified for use in the Delaware and Hudson Rivers.

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). 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). 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. Based on five fishery-independent surveys, Dunton *et al*. (2010) identified several "hotspots" for Atlantic sturgeon captures, including an area off Sandy Hook, New Jersey, and off Rockaway, New York. 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). 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). 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. South of Cape Cod, the nearest rivers to the WDA that is known to regularly support Atlantic sturgeon spawning is the Hudson River. Atlantic sturgeon may also at least occasionally spawn in the Connecticut River. The Delaware River also supports a population of spawning Atlantic sturgeon.

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 south of the New England Wind WDA, it is reasonable to expect that distribution and use of the New England Wind 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. The NEAMAP trawl survey 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 action area. 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.

Between March 2009 and February 2012, 173 Atlantic sturgeon were documented as bycatch in Federal fisheries by the Northeast Observer Program. Observers operated on fishing vessels from the Gulf of Maine to Cape Hatteras. Observer Program coverage across this entire area for this period was 8% of all trips with the exception that Observer coverage for the New England ground fish fisheries, extending from Maine to Rhode Island, was an additional 18% (26% coverage in total). Despite the highest observer coverage in the ground fish fisheries that overlap with the action area and the regular occurrence of commercial fishing activity in the area, only 2 of the 173 Atlantic sturgeon observed by the observer program in this period were collected in the MA/RI portion of the action area.

Dunton et al. (2015) documented sturgeon bycatch in waters less than 50 feet deep during the New York summer flounder fishery; 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 off the coast of New York 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.

None of the scientific literature that has examined the distribution of Atlantic sturgeon in the marine environment has identified the WDA 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 WDA. Based on the location of spawning rivers both north and south of the WDA and the general distribution of Atlantic sturgeon in the marine environment, individual Atlantic sturgeon are expected to be moving through the WDA during the warmer months of the area and may be foraging opportunistically in areas where benthic invertebrates are present; however, the area is not known to be a preferred foraging area. Individual Atlantic sturgeon may be present in the WDA year-round. In the lease area and along the cable corridor (i.e., the WDA), the majority of individuals will be from the Gulf of Maine and New York Bight DPSs.

Atlantic sturgeon in the Delaware River

The November 2023 Paulsboro Biological Opinion discusses the status of Atlantic 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. In the Delaware River and Estuary, Atlantic sturgeon occur from the mouth of the Delaware Bay to the fall line near Trenton, New Jersey, a distance of almost 220 km (136.7 mi) (Hilton *et al.* 2016, Simpson 2008). An Atlantic sturgeon carcass was found at Easton, Pennsylvania (i.e., above the fall line of the Delaware River) in 2014 (NMFS 2017) suggesting that Atlantic sturgeon can move past the fall line. However, tracking and tagging information support that the fish typically occur downriver of the fall line (NMFS 2022). Spawning occurs in the spring in the fresh water reach of the river. All early life stages are intolerant of high salinity and only occur in the freshwater reach of the river. Juvenile Atlantic sturgeon are present from the mouth of the Delaware River and upstream to Trenton, New Jersey. Adult and subadult Atlantic sturgeon are present in Delaware Bay and the river. Atlantic 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.

Atlantic sturgeon in the Hudson River and New York Harbor

Use of the Hudson River by Atlantic sturgeon has been described by several authors. The area around Hyde Park (approximately rkm134) has consistently been identified as a spawning area through scientific studies and historical records of the Hudson River sturgeon fishery (Dovel and Berggren, 1983; Van Eenennaam *et al.*, 1996; Kahnle *et al.*, 1998; Bain *et al.*, 2000). Habitat conditions at the Hyde Park site are described as freshwater year- round with bedrock, silt, and clay substrates and waters depths of 12-24 m (Bain *et al.*, 2000). Bain *et al.* (2000) also identified a spawning site at rkm 112 based on tracking data. The rkm 112 site, located to one side of the river, has clay, silt and sand substrates, and is approximately 21-27 m deep (Bain *et al.*, 2000).

Young-of-year (YOY) have been recorded in the Hudson River between rkm 60 and rkm 148, which includes some brackish waters; however, larvae must remain upstream of the salt wedge because of their low salinity tolerance (Dovel and Berggren, 1983; Kahnle *et al.*, 1998; Bain *et al.*, 2000). Catches of immature sturgeon (age 1 and older) suggest that juveniles utilize the estuary from the Tappan Zee Bridge through Kingston (rkm 43- rkm 148) (Dovel and Berggren, 1983; Bain *et al.*, 2000). Seasonal movements are apparent with juveniles occupying waters from rkm 60 to rkm 107 during summer months and then moving downstream as water temperatures decline in the fall, primarily occupying waters from rkm 19 to rkm 74 (Dovel and Berggren, 1983; Bain *et al.*, 2000). Based on river-bottom sediment maps (Coch, 1986) most juvenile sturgeon habitats in the Hudson River have clay, sand, and silt substrates (Bain *et al.*, 2000). Newburgh and Haverstraw Bays in the Hudson River are areas of known juvenile sturgeon concentrations (Sweka *et al.*, 2007). Sampling in spring and fall revealed that highest catches of juvenile Atlantic sturgeon occurred during spring in soft-deep areas of Haverstraw Bay even though this habitat type comprised only 25% of the available habitat in the Bay (Sweka *et al.*, 2007). Overall, 90% of the total 562 individual juvenile Atlantic sturgeon captured during the course of this study (14 were captured more than once) came from Haverstraw Bay (Sweka *et al.*, 2007). At around 3 years of age, Hudson River juveniles exceeding 70 cm total length begin to migrate to marine waters (Bain *et al.*, 2000). New aging analyses of fin spines from 520 Atlantic sturgeon captured in Sweka et al. (2007) reaffirms the use of Newburgh and Haverstraw bays by New York Bight DPS juveniles and, likely, subadults as well. Sturgeon as young as one-year old and as old as eight years were present in the bays in the spring and the fall. Four-year-old sturgeon were the most prevalent age group (Kehler et al. 2018). The presence of fish from age-one through age-eight across multiple seasons confirms that Newburgh and Haverstraw bays are important juvenile habitat for the New York Bight DPS and for the Hudson River spawning population, in particular.

Atlantic sturgeon adults are likely to migrate through the Hudson River portion of the action area in the spring as they move from oceanic overwintering sites to upstream spawning sites and then migrate back through the area as they move to lower reaches of the estuary or oceanic areas in the late spring and early summer. Atlantic sturgeon adults are most likely to occur in the action area from May – September. Tracking data from tagged juvenile Atlantic sturgeon indicates that during the spring and summer individuals are most likely to occur within rkm 60-170. During the winter months, juvenile Atlantic sturgeon are most likely to occur between rkm 19 and 74. This seasonal change in distribution may be associated with seasonal movements of the saltwedge and differential seasonal use of habitats.

Based on the available data, Atlantic sturgeon may be present in the Hudson River portion of the action area year-round. Atlantic sturgeon in this portion of the action area likely originated from the New York Bight DPS, Chesapeake Bay DPS, and Gulf of Maine DPS, with the majority of individuals originating from the New York Bight DPS, and the majority of those individuals originating from the Hudson River.

Summary of Atlantic sturgeon distribution in the action area

In summary, Atlantic sturgeon occur in most of the action area; with the exception being 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. In the portion of the action area including the WFA and along the cable corridors, the majority of individuals will be from the New York Bight DPS. Considering the action area as a whole, individuals from all 5 DPSs may be present.

Shortnose sturgeon

The only portion of the action area that overlaps with the distribution of shortnose sturgeon is the vessel transit routes in the Delaware River and Hudson River where vessels transiting between the identified ports and the WDA will travel.

Shortnose sturgeon in the Delaware River

The November 2023 Paulsboro 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 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.

Shortnose sturgeon in the Hudson River

Historically, shortnose sturgeon have been documented in the Hudson River from upper Staten Island (RM -3(rkm -4.8)) to the Troy Dam (RM 155 (rkm 249.5); for reference, the project area for infrastructure improvements at SBMT is located at RM -3.5 (rkm -5.6)) (Bain et al. 2000, ASA 1980-2002). Prior to the construction of the Troy Dam in 1825, shortnose sturgeon are thought to have used the entire freshwater portion of the Hudson River (NYHS 1809). Spawning fish congregated at the base of Cohoes Falls where the Mohawk River emptied into the Hudson. Since 1999, shortnose sturgeon have been documented below the Tappan Zee Bridge from June through December (ASA 1999-2002; Dynegy 2003). While shortnose sturgeon presence below the Tappan Zee Bridge had previously been thought to be rare (Bain et al. 2000), increasing numbers of shortnose sturgeon have been documented in this area (ASA 1999-2002; Dynegy 2003) suggesting that the range of shortnose sturgeon is extending downstream. Shortnose sturgeon were documented as far south as the Manhattan/Staten Island area in June, November, and December 2003 (Dynegy 2003). While there are a few records of shortnose sturgeon in Upper New York Bay, shortnose sturgeon were recently captured near Liberty Island (approximately 3 km up bay of SBMT) (USACE, 2021).

From late fall to early spring, adult shortnose sturgeon concentrate in a few overwintering areas. Reproductive activity the following spring determines overwintering behavior. The largest overwintering area is just south of Kingston, NY, near Esopus Meadows (RM 86-94, rkm 139-152) (Dovel et al. 1992). The fish overwintering at Esopus Meadows are mainly spawning adults. Capture data suggests that these areas may be expanding (Hudson River 1999-2002, Dynegy 2003). Captures of shortnose sturgeon during the fall and winter from Saugerties to Hyde Park (greater Kingston reach), indicate that additional smaller overwintering areas may be present (Geoghegan et al. 1992). Both Geoghegan et al. (1992) and Dovel et al. (1992) also confirmed an overwintering site in the Croton-Haverstraw Bay area (RM 33.5 – 38, rkm 54-61). The SBMT is located approximately 59.6 km (37 miles) south of the southern extent of this overwintering area, which is near rkm 54 (RM 33.5). Fish overwintering in areas below Esopus Meadows are mainly thought to be pre-spawning adults. Typically, movements during overwintering periods are localized and fairly sedentary.

In the Hudson River, males usually spawn at approximately 3-5 years of age while females spawn at approximately 6-10 years of age (Dadswell et al. 1984; Bain et al. 1998). Males may spawn annually once mature and females typically spawn every 3 years (Dovel et al. 1992). Mature males feed only sporadically prior to the spawning migration, while females do not feed at all in the months prior to spawning.

In approximately late March through mid-April, when water temperatures are sustained at 8º-9° C (46.4-48.2°F) for several days[27], reproductively active adults begin their migration upstream to the spawning grounds that extend from below the Federal Dam at Troy to about Coeymans, NY (rkm 245-212 (RM 152-131) (Dovel et al. 1992); located more than 169 km (104 miles) upstream from the Tappan Zee Bridge). Spawning typically occurs at water temperatures between 10 and 18°C (50-64.4°F) (generally late April-May) after which adults disperse quickly down river into their summer range. Dovel et al. (1992) reported that spawning fish tagged at Troy were recaptured in Haverstraw Bay in early June. The broad summer range occupied by adult shortnose sturgeon extends from approximately rkm 38 to rkm 177 (RM 23.5-110). The Tappan Zee Bridge (at rkm 43) is located within the broad summer range.

There is scant data on actual collection of early life stages of shortnose sturgeon in the Hudson River. During a mark recapture study conducted from 1976-1978, Dovel et al. (1979) captured larvae near Hudson, NY (rkm 188, RM 117) and young of the year were captured further south near Germantown (RM 106, rkm 171). Between 1996 and 2004, approximately 10 small shortnose sturgeon were collected each year as part of the Falls Shoals Survey (FSS) (ASA 2007). Based upon basic life history information for shortnose sturgeon it is known that eggs adhere to solid objects on the river bottom (Buckley and Kynard 1981; Taubert 1980) and that eggs and larvae are expected to be present within the vicinity of the spawning grounds (rkm 245 212, RM 152-131) for approximately four weeks post spawning (i.e., at latest through mid-June). Shortnose sturgeon larvae in the Hudson River generally range in size from 15 to 18 mm (0.6-0.7 inches) TL at hatching (Pekovitch 1979). Larvae gradually disperse downstream after hatching, entering the tidal river (Hoff et al. 1988). Larvae or fry are free swimming and typically concentrate in deep channel habitat (Taubert and Dadswell 1980; Bath et al. 1981; Kieffer and Kynard 1993). Given that fry are free swimming and foraging, they typically disperse downstream of spawning/rearing areas. Larvae can be found upstream of the salt wedge in the Hudson River estuary and are most commonly found in deep waters with strong currents, typically in the channel (Hoff et al. 1988; Dovel et al. 1992). Larvae are not tolerant of saltwater and their occurrence within the estuary is limited to freshwater areas. The transition from the larval to juvenile stage generally occurs in the first summer of life when the fish grows to approximately 2 cm (0.8 in) TL and is marked by fully developed external characteristics (Pekovitch 1979).

Similar to non-spawning adults, most juveniles occupy the broad region of Haverstraw Bay (rkm 55-64.4) RM 34-40; Indian Point is located near the northern edge of the bay) (Dovel et al. 1992; Geoghegan et al. 1992) by late fall and early winter. Migrations from the summer foraging areas to the overwintering grounds are triggered when water temperatures fall to 8°C (46.4°F) (NMFS 1998), typically in late November[28]. Juveniles are distributed throughout the mid-river region during the summer and move back into the Haverstraw Bay region during the late fall (Bain et al.

[27] Based on information from the USGS gage in Albany (gage no. 01359139), in 2002 mean water temperatures reached 8ºC on April 10 and 15ºC on April 20; 2003 - 8ºC on April 14 and 15ºC on May 19; 2004 - 8ºC on April 17 and 15ºC on May 11. In 2011, water temperatures reached 8°C on April 11 and reached 15°C on May 19. In 2012, water temperatures reached 8°C on March 20 and reached 15°C on May 13.

[28] In 2002, water temperatures at the USGS gage at Hastings-on-Hudson (No. 01376304; the farthest downstream

1998; Geoghegan et al. 1992; Haley 1998).

The Hudson River population of shortnose sturgeon is almost exclusively confined to the river, unlike other populations that use coastal marine waters to move between rivers (Pendleton et al. 2019; Kynard et al. 2016). Telemetry data from the Gulf of Maine indicate shortnose sturgeon in this region undertake significant coastal migrations between larger river systems and utilize smaller coastal river systems during these interbasin movements (Fernandes 2008; UMaine unpublished data). Some outmigration has been documented in the Hudson River, albeit at low levels in comparison to coastal movement documented in the Gulf of Maine and Southeast rivers. Two individuals tagged in 1995 in the overwintering area near Kingston, NY were later recaptured in the Connecticut River. One of these fish was at large for over two years and the other 8 years prior to recapture. As such, it is reasonable to expect some level of movement out of the Hudson into adjacent river systems; however, based on available information it is not possible to predict what percentage of adult shortnose sturgeon originating from the Hudson River may participate in coastal migrations. As described above, shortnose sturgeon overwinter in the rivers, so the time of year for coastal migrations would be roughly from April 1 to November 30, when they may occur within the 40.80°N, longitude -72.87°W 50-m (165-ft) depth contour (Zydlewski, et al. 2011).

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

Activities in the Coastal and Riverine Portions of the Action Area
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 New York Harbor, and the Delaware River. 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 New England Wind project.

Fishing Activity in the Action Area
Commercial and recreational fishing occurs throughout the action area. The New England Wind lease is a small portion (<1%) of NMFS statistical area 537 and the cable route extends through 537 to area 538. Transit routes to identified ports 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

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gage on the river) fell to 8°C on November 23. In 2003, water temperatures at this gage fell to 8°C on November 29.
In 2010, water temperatures at the USGS gage at West Point, NY (No. 01374019; currently the farthest downstream gage on the river) fell to 8°C on November 23. In 2011, water temperatures at the USGS gage at West Point, NY (No. 01374019) fell to 8°C on November 24. This gage ceased operations on March 1, 2012.

the Magnuson-Stevens Fishery Conservation and Management Act. 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.

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 blue, 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. 2022, 2021, and 2020 and Henry et al. 2022). 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 blue and sperm whales as reported in the most recent SAR for blue whales and sperm whales in the North Atlantic (Hayes et al. 2020). 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[29]. Of the 122 right whales in the UME (as of February 10, 2024), 9 mortalities are attributed to entanglement as well as 31 serious injuries and 39 sublethal injuries. We note that 1 mortality is listed as "pending"; this is the female stranded on Martha's Vineyard in January 2024. While no cause of death has been determined, preliminary indications are that there was no sign of vessel strike and that the individual had

[29] Information in this paragraph related to the UME is available at: *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2024 -north-atlantic-right-whale-unusual-mortality-event*; last accessed on November 10 , 2024

previously been documented with an entanglement. None of the whales recorded as part of the UME were first documented in the WDA[30]. We reviewed information on serious injury and mortalities reported in Henry et al. 2022. Six live right whales were first documented as entangled in waters off the coast of southern Massachusetts; right whale 3139 was documented showing entanglement related injuries (without gear currently present) on July 4, 2017 approximately 1.5 nm south of Nantucket, MA, right whale 4091 was documented as free-swimming with a line trailing from it on May 12, 2018 approximately 53.7 nm east of Chatham, MA. North Atlantic right whale 3208 was observed injured without gear present on December 1, 2018, 30.8 nm south of Nantucket, MA. On December 20, 20218, right whale 2310 was observed swimming with gear through the mouth 238.5 nm southeast of Nantucket, MA, and on December 27, 2018, right whale 3950 was observed with new, healed injuries without gear present and was located 16.3 nm south of Nantucket, MA. North Atlantic right whale 3466 was seen swimming 20.03 nm south of Nantucket, MA on December 21, 2019. It was free-swimming, but multiple lines were seen around the mouth and trailed behind the whale for approximately 1 body length, and subsequent sightings indicated the gear was shed successfully with evidence of healing injuries. It is unknown where these entanglements actually occurred. Henry et al. 2022 includes no records of entangled fin, sei, blue, or sperm whales first reported in waters between Long Island, NY to Nantucket Shoals. Henry et al. 2022 presented three documented human-caused mortality events for North Atlantic right whales in the coastal area between Long Island, NY and Martha's Vineyard, MA since 2016. The first was the right whale 4681 located near Morris Island, MA (southeast of Cape Cod) on May 3, 2016 due to sharp trauma. The following two were unknown whales on August 6, 2017 and August 25, 2018 and both where near Martha's Vineyard, MA. The whale found on August 6, 2017 had no gear present, but showed signs of constriction associated with gear and evidence of subsequent hemorrhaging, and similarly the whale found on August 25, 2018 had no gear present, but showed evidence of acute entanglement surrounding the pectoral area as well as hemorrhaging.

Given the co-occurrence of fisheries and large whales in the action area, it is assumed 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

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[30] https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=e502f7daf4af43ffa9776c17c2aff3ea; last accessed July 17, 2023

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 (2018-2022) were queried for the number of reports of Atlantic sturgeon bycatch in the statistical areas that overlap with the lease area and cable routes (537 and 538[23]). 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 (2018-2022), a total of 15 Atlantic sturgeon were reported as bycatch in bottom otter trawls and gillnets in these two statistical areas, this represents less than 5% of the total observed 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. Note that the WDA occupies only a portion of area 537, with the cable routes extending into area 538. 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 commercial otter trawls and 70% in commercial gillnets), bycatch is expected to be a primary source of mortality of Atlantic sturgeon in the action area.

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, there were a total of 5 incidents of observed sea turtle bycatch in gillnet, trap/pot, and bottom otter trawl fisheries in areas 537 and 538 (2 leatherback, 2 loggerhead and 1 unknown). Leatherback sea turtles are particularly vulnerable to entanglement in vertical lines. Since 2005, over 230 leatherbacks have been reported entangled in vertical lines in Massachusetts alone. 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. Where possible, turtles are disentangled and may be brought back to rehabilitation facilities for treatment and recovery. This helps to reduce the rate of death from entanglement. The Southeast STDN provides similar services in the South Atlantic and Gulf of Mexico. 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 in NY and NJ
Vessel traffic along the mid-Atlantic 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 Port of New York/New Jersey and the Delaware River/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.

Vessel Traffic in the Lease Area and Surrounding Waters
In the COP, New England Wind reports on vessel traffic in the WDA based on AIS data. Based on this data, the most common type of vessels transiting in the WDA are commercial fishing and recreational vessels. The data show that traffic is most dense through Rhode Island Sound and along the traffic separation zones.

The marine component of the action area supports considerable vessel traffic, ranging from thousands of large and small vessel trips per year near coastal areas and in and around major shipping lanes to dozens of vessel trips in some low-traffic areas in the New England Wind WFA (Epsilon 2022). Epsilon (2022) summarized vessel traffic in the vicinity of the proposed action based on AIS data from 2016 through 2019. Historical traffic in the lease area is relatively low with a seasonal peak of 6.4 vessels per day in August and 0.5 vessels per day during the winter months (Epsilon 2022). The data include eight vessel classes: cargo/carrier, fishing, other and unidentified, passenger, pleasure, tanker, tanker – oil, and tug and service. Vessel lengths ranged from 13 m to 332 m, vessel beams ranged from 6 m to 50 m (Epsilon 2022). The majority of the vessels in the SWDA were either fishing or recreational, though cargo, tanker, passenger, tug-tow, military, and other vessels were also recorded (Epsilon 2022). Seven military vessels operated in the Lease Area during this period. Between January 1, 2016, and December 31, 2019, 10,660 unique vessel tracks were assessed in the AIS dataset (Epsilon 2022). Approximately 59% of vessel traffic in the lease area was attributed to fishing vessels. The levels of vessel traffic observed by Epsilon (2022) for 2018 to 2019 is broadly consistent with the findings of the U.S. Coast Guard (USCG 2020) analysis of vessel traffic patterns in the same area for the period from 2015 through 2018. However, as described below, the levels of vessel traffic in the general vicinity increased significantly from 2015 to 2018 (USCG 2020).

Table 6.2. Vessel Types within the Lease Area during 2016-2019 (Epsilon 2022).

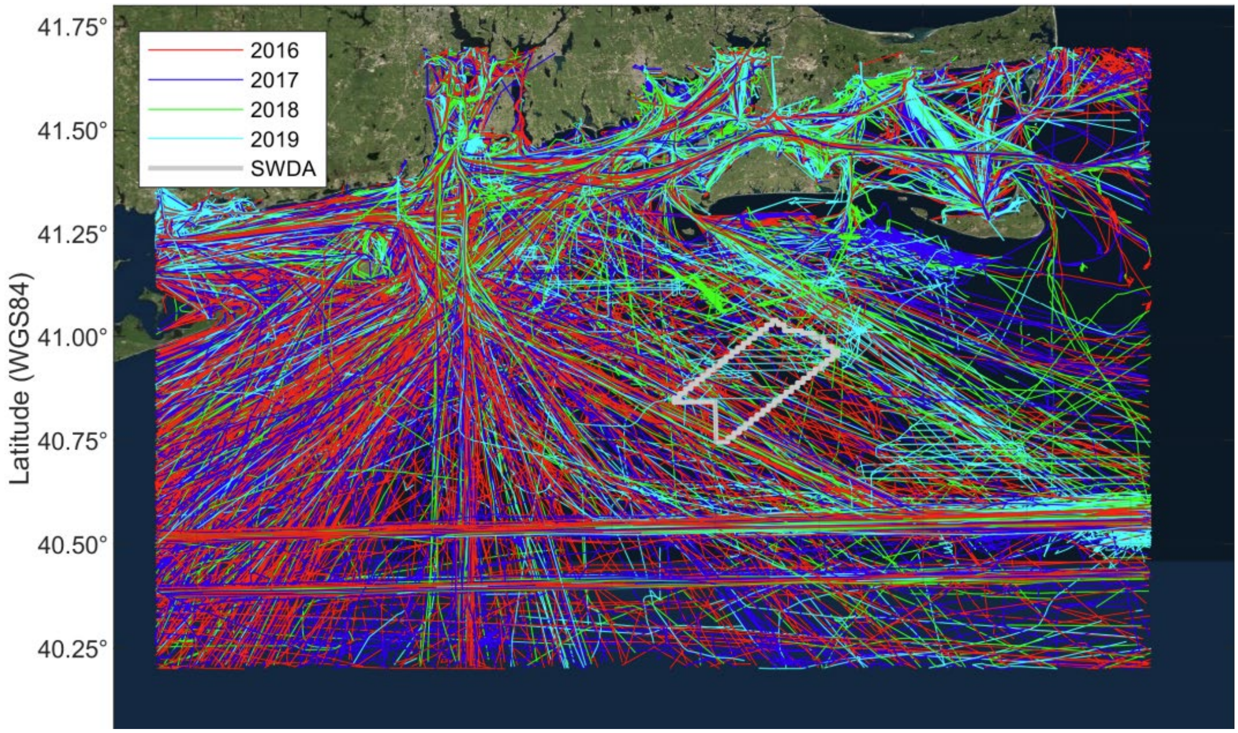
	Unique Vessels	
Vessel Type	**Number**	**Percentage**
Cargo Vessel	112	13%
Tankers	85	10%
Passenger Vessels	17	2%
Tug-barge Vessels	12	1%
Military Vessels	7	1%
Naval Sail Training Vessels	2	0.20%
Recreational Vessels	325	39%
Fishing Vessels, Transit	228	27%
Fishing Vessels, Fishing	92	11%
Other Vessels	42	5%

Traffic along or crossing the Offshore Export Cable Corridor (OECC) which connects the lease area to the coastline of Massachusetts was also analyzed. Most of the vessel crossing traffic occurs between Martha's Vineyard and the mainland of Cape Cod. Overall, vessel traffic density along the OECC is relatively low, including the Phase 2 OECC Western Muskeget Variant, with the highest concentration of traffic midway through Nantucket Sound. On average, 71 vessels crossed the OECC daily in 2019 (Epsilon 2022). See Appendix III-I of the COP for a detailed description of vessel traffic patterns and statistics.

General vessel traffic in the area surrounding the lease area varies, ranging from thousands of large and small vessel trips in and around major shipping lanes to dozens of vessel trips in the low-traffic areas in the WFA (Epsilon 2022). Epsilon (2022) analyzed vessel traffic patterns in the WDA to assess navigation safety risks using a two-step analysis. The first step relied on quantification of vessel transits through designated cross sections in proximity to the action area using AIS data for all vessel classes. The second step relied on Vessel Monitoring System (VMS) data for fishing vessels. The VMS system provides location data used by NMFS to monitor fishing activity while maintaining confidentiality.

Figure 6.1 below (from Appendix III-I) displays AIS vessel tracks in proximity to the proposed project footprint, regional traffic corridors, and port entrances.

Figure 6.1. Vessel Track Plots by Year for Whole AIS Data Set – Every 50th Track Plotted (Epsilon 2022).



The USCG (2020) vessel traffic analysis also summarized vessel traffic by class in the RI/MA WEA and surroundings. USCG data indicate a substantial increase in vessel traffic in the defined study area[31] from 2015 through 2018

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). The Block Island SMA, overlaps with the portion of the action area where the project will be constructed. All vessels 65 feet or longer that transit the SMA 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

[31] The MARIPARS study area is bounded by a rectangular area defined by the following corner coordinates: (1) 41°20′ N, 070°00′ W; (2) 40°35′ N, 070°00′ W; (3) 40°35′ N, 071°15′ W; (4) 41°20′ N, 071°15′ W.

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.

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, 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, and 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 blue or sperm whales have been documented (Hayes et al. 2020). A review of available data on serious injury and mortality determinations for blue, sei, fin, and sperm whales for 2000-2020 and right whales for 2000-2023 (Henry et al. 2022, UME website as cited above), includes no records of whales that were first detected in the WDA. The nearest records identified in the UME are three right whales documented in 2017 and 2018 in moderate to advanced decomposition off the southern coast of Martha's Vineyard[32]. 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 Rhode Island and Massachusetts, south and east of Cape Cod to overlap with the area where the majority of project vessel traffic will occur. Out of the 59 recovered stranded sea turtles in the southern New England region during the most recent three year period (2020-2022) for which data was available, there were 33 recorded sea turtle vessel strikes, primarily between the months of August and November.

The majority of strikes were of leatherbacks with a smaller number of loggerhead and green; there was one record of Kemp's ridleys struck in the area for which data was obtained. 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.

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. Shortnose sturgeon appear to be less vulnerable to vessel strike than Atlantic sturgeon. NMFS has only minimum counts of the number of Atlantic sturgeon that are struck and killed by vessels because only sturgeon that are found dead with evidence of a vessel strike are counted. New research, including a study that intentionally placed Atlantic sturgeon carcasses along the Delaware River in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our

[32] https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=e502f7daf4af43ffa9776c17c2aff3ea; last accessed 1/22/24

sturgeon salvage co-investigators (Balazik et al. 2012b, Balazik, pers. comm. in ASMFC 2017; Fox et al. 2020).

A summary of information on vessel strikes of Atlantic sturgeon in the Delaware River and Bay and the Hudson River 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 influence the environmental baseline for this action.

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 New England Wind project, BOEM estimates up to 100 trips to the Paulsboro Marine Terminal (Table 1-10 in the BA) during the construction phase. This is approximately 11.4% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, New England Wind 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 or shortnose 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 11.4% of the total vessel strikes of sturgeon could result from New England Wind project vessels. Calculating 11.4% of 8 Atlantic sturgeon results in an estimate of 0.91 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the New England Wind project will result in the strike of no more than one Atlantic sturgeon. Based on the proportional assignment of take in the November 2023 Paulsboro Opinion, we expect that this is likely to be an Atlantic sturgeon belonging to the New York Bight DPS. Calculating 11% of 1 shortnose sturgeon results in an estimate of 0.11 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the New England Wind 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. 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 New England Wind project.

With the exception of monitoring required by our Biological Opinions, the approach to monitoring for dead sturgeon in the Hudson River has been opportunistic, and has not involved a systematic strategy for surveying and recording occurrences. Prior to 2011, there was minimal awareness that vessel strike constituted a threat to sturgeon. According to the NYSDEC, record keeping became more intensive around 2011-2012 as a result of the recognition that Atlantic sturgeon on the Delaware River were being struck by large commercial vessels. From 2007-2011, the NYSDEC recorded four specific types of information when a sturgeon mortality was reported, i.e., date, observer contact, location of the sturgeon, and condition of the sturgeon. Sturgeon species was not specifically recorded, nor was the suspected cause of death. Beginning in 2012, a more comprehensive record keeping program was initiated by NYSDEC to document sturgeon mortalities in the Hudson River. At this point, they began recording approximately 12 specific types of information for each reported mortality, including sturgeon ID number, species, date, contact information, location, photo-documentation, body length, condition, disposition following the sighting, possible vessel strike, if the sturgeon was scanned for ID tags and painted, and other relevant comments.

As observations have largely been opportunistic, monitoring effort has not been consistent year to year or from place to place. It can be assumed that the listing of Atlantic sturgeon under the ESA in 2012 and the publicity associated with the construction of the new Tappan Zee Bridge led to increased public awareness of possible threats to the species. Additionally, Hudson Riverkeeper posted information on its website in 2012 and again in 2013 and the Thruway Authority distributed pamphlets and posted signage in 2014 to encourage public reporting. These public outreach efforts have likely contributed to the increased number of reports since in-water activities began in 2012. A focused monitoring effort by the NYSTA and TZC in the vicinity of the bridge also contributes to the number of sturgeon mortalities reported after 2012. Several of the conditions of the environmental permits for the Project, related to monitoring for dead or injured sturgeon in the project area, including vessel transects with observers.
As mentioned above, any sample of sturgeon mortalities in the Hudson River is not going to indicate the actual number of affected sturgeon, rather it will represent the minimum number killed, and without a standardized sampling effort it is not possible to develop a reliable estimate of the total number of dead sturgeon in the river, or to compare one river reach to another. A summary of information from the NYSDEC database for 2013-2017 is presented in the table below.

Table 6.3. A summary of the number of dead sturgeon observed in the Hudson River from 2013-2017 based on data in the NYDEC database.

	Total Mortalities	Assumed Vessel Mortalities
Atlantic Sturgeon		
2013	17	10
2014	24	18
2015	35	24
2016	13	4
2017	19	15
2013-2017	**108**	**71**
Shortnose Sturgeon		
2013	6	1
2014	8	0
2015	9	3
2016	9	2
2017	3	3
2013-2017	**35**	**9**
Unidentified Sturgeon		
2013	2	0
2014	9	3
2015	5	0
2016	5	0
2017	1	0
2013-2017	**22**	**3**
Total	**165**	**83**

As indicated above, although the information derived from the NYSDEC database is informative, it is only a sample of the sturgeon that died in the Hudson River over this time period and does not represent the total number because of the opportunistic nature of reporting and the likelihood that some sturgeon died but were not observed and reported. Additionally, the monitoring effort likely correlates spatially with human population density and boating activity, whereby the more populous areas in the lower river undergo higher levels of monitoring effort than the more sparsely populated areas upriver. For these reasons, the database should only be considered to represent the absolute minimum number of sturgeon that were killed in the Hudson River.

From 2013 to 2020, NYSDEC reported 13 Atlantic sturgeon carcasses in New York Bay that had some evidence of a possible vessel strike. These carcasses were not examined and we do not have an estimate of the total number of vessel strikes in this area annually.
We expect that Atlantic and shortnose sturgeon will continue to be struck and killed in the Hudson River portion of the action area, inclusive of New York Bay, over the life of the proposed action.

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. 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) as well as ongoing effects of construction of the South Fork and Vineyard Wind 1 projects.

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, Revolution Wind, Sunrise Wind, CVOW, Empire Wind, and Atlantic Shores South). To date, construction has only started for South Fork Wind (foundation installation complete) and Vineyard Wind 1; these projects are located outside the New England Wind WFA but the within the action area with the Vineyard Wind 1 project is adjacent to the New England Wind Project. We have also completed ESA section 7 consultation on one smaller scale offshore wind project that occurs in the action area, the Block Island project; this project is in the operations and maintenance phase. Dominion's Coastal Virginia Offshore Wind Demonstration Project consists of two operational WTGs off the coast of Virginia; this project is outside of the action area. The offshore wind projects that we have completed consultation on that are within the action area defined in section 3.9 of this Opinion are Vineyard Wind 1, South Fork Wind, Ocean Wind 1 (noting that status of this project is uncertain), Revolution Wind, Sunrise Wind, and Atlantic Shores South. Vessels transiting between the New England Wind WDA and ports in New York and New Jersey would travel past the Empire Wind, Ocean Wind 1 and Atlantic Shores lease areas.

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 action area to support OSW development; surveys for the Vineyard Wind 1 and South Fork projects were considered in the Biological Opinions issued for those projects. Some gear types used, including gillnet, trawl, and trap/pot, can entangle or capture ESA listed sea turtles, fish, and whales. 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. To date, we have records of ten Atlantic sturgeon captured in gillnet surveys (for the South Fork project) in the action area; six of the sturgeon were released alive with minor injuries while the remaining four were killed. South Fork does not anticipate further gillnet survey efforts at this time. A number of Atlantic sturgeon have also been captured in trawl surveys; however, all animals have been released alive with no serious injuries observed. 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. Outside of the gillnet surveys, which are no longer planned, no serious injury or mortality of any ESA listed species is exempted in any ITS issued for any of these projects.

Consideration of Construction, Operation, and Decommissioning of Other OSW Projects
We have completed ESA consultation for 10 OSW projects to date. Complete information on the assessment of effects of these 10 projects is found in their respective Biological Opinions (South Fork Wind - NMFS 2021a, Vineyard Wind 1 - NMFS 2021b, CVOW - NMFS 2016, and Block Island - NMFS 2014, Ocean Wind – NMFS 2023a, CVOW – NMFS 2023b, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2023d, Sunrise Wind – 2023e, Atlantic Shores South – 2023f). The Block Island and CVOW Demonstration projects have been constructed and turbines are operational. Construction of the Vineyard Wind 1 and South Fork projects is ongoing and expected to be complete prior to the beginning of construction of the New England Wind project. Given numerous project delays, it is difficult to predict which, if any, projects may be undergoing construction during the same years as the New England Wind project. We note that in January 2024, the lessee for the Ocean Wind 1 project requested to suspend their lease; as such, it is not clear if that project will be constructed in the future. The CVOW Demonstration and CVOW Commercial projects are outside the New England Wind action area. The South Fork, Vineyard Wind 1, Revolution Wind, and Sunrise Wind lease areas are in the MA or MA-RI WEAs and are proximate to the New England Wind lease area and within the action area. The Atlantic Shores South and Empire Wind lease areas are within the portion of

the action area that project vessels may transit. We provide more information below on the projects in the action area.

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 projects that occur in the New England Wind action area (Tables 6.2 and 6.3). In the Biological Opinions prepared for the offshore wind projects considered to date, we anticipated short term behavioral disturbance of ESA listed sea turtles and whales exposed to pile driving noise. In these Opinions, we concluded that effects of operational noise would be insignificant. With the exception of the gillnet interactions noted above, 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 the South Fork, Vineyard Wind 1, Ocean Wind 1, Empire Wind, Revolution Wind, Sunrise Wind, and Atlantic Shores South projects.

Table 6.4. Summary of available Incidental Take Statements (ITS) regarding project noise (pile driving and/or UXO detonations) for the following completed offshore wind consultations. Note that not all construction periods overlap. Source: Ocean Wind – NMFS 2023a, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2023d, Sunrise Wind – 2023e, Atlantic Shores South – 2023f, South Fork Wind - NMFS 2021a, and Vineyard Wind 1 - NMFS 2021b.

South Fork Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact and Vibratory Pile Driving)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	10
Fin Whale	1	15
Sei Whale	1	2
Sperm whale	None	3
NA DPS green sea turtle	None	6
Kemp's ridley sea turtle	None	6
Leatherback sea turtle	None	8
NWA DPS Loggerhead sea turtle	None	6
Vineyard Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Maximum Impact Scenario; Impact Pile Driving Only)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)

North Atlantic right whale	None	20
Fin whale	5	5
Sei Whale	2	2
Sperm whale	None	None
NWA DPS Loggerhead sea turtle	None	3
NA DPS green sea turtle	None	1
Kemp’s ridley sea turtle	None	1
Leatherback sea turtle	None	7
Ocean Wind 1 - Amount and Extent of Take Identified 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
Revolution Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Exposure to Noise (UXO Detonation and Impact Pile Driving)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	34
Fin whale	None	33
Sei Whale	None	16
Sperm whale	None	5
Blue whale	None	2
NA DPS green sea turtle	None	8
Kemp’s ridley sea turtle	None	7
Leatherback sea turtle	None	7

NWA DPS Loggerhead sea turtle	None	15
Empire Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	22
Fin whale	6	190
Sei Whale	None	5
Sperm whale	None	6
NA DPS green sea turtle	None	1
Kemp’s ridley sea turtle	None	9
Leatherback sea turtle	None	2
NWA DPS Loggerhead sea turtle	None	96
Sunrise Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	23
Fin whale	4	55
Sei Whale	2	22
Sperm whale	None	10
Blue whale	None	2
NA DPS green sea turtle	None	1
Kemp’s ridley sea turtle	None	1
Leatherback sea turtle	4	9
NWA DPS Loggerhead sea turtle	None	7
Atlantic Shores South - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		
Species	Harm (Auditory Injury -PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	20
Fin whale	8	28

Sei Whale	3	15
Sperm whale	None	10
NA DPS green sea turtle	None	2
Kemp's ridley sea turtle	None	48
Leatherback sea turtle	4	25
NWA DPS Loggerhead sea turtle	None	816

Table 6.5. Summary of available Incidental Take Statements (ITS) regarding vessel strikes for the following completed offshore wind consultations. The amount of take identified is over the life of the project (construction, operations, and decommissioning). Source: Ocean Wind – NMFS 2023a, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2023d, Sunrise Wind – 2023e, Atlantic Shores South – 2023f, South Fork Wind - NMFS 2021a, and Vineyard Wind 1 - NMFS 2021b.

South Fork Wind - 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	7
NWA DPS Loggerhead sea turtle	3
Vineyard Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS Due to Vessel Strike	
Species	Serious Injury or Mortality
NWA DPS Loggerhead sea turtle	17
NA DPS green sea turtle	2
Kemp's ridley sea turtle	2
Leatherback sea turtle	20
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
Revolution Wind -Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	Serious Injury or Mortality

North Atlantic DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	5
Northwest Act DPS Loggerhead sea turtle	6
Empire Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	Serious Injury or Mortality
North Atlantic DPS green sea turtle	1
Kemp's ridley sea turtle	3
Leatherback sea turtle	4
Northwest Atlantic DPS Loggerhead sea turtle	22
Sunrise Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	Serious Injury or Mortality
North Atlantic DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	5
Northwest Atlantic DPS Loggerhead sea turtle	6
Atlantic Shores South - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	Serious Injury or Mortality
North Atlantic DPS green sea turtle	2
Kemp's ridley sea turtle	3
Leatherback sea turtle	2
Northwest Atlantic DPS Loggerhead sea turtle	21

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 (i.e., no more than one or two incidents per permit and only a few individuals overall). 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 New England Wind 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. Kraus et al. (2016) surveyed the ambient underwater noise environment in the RI/MA WEA 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 are depicted in Figure 11 of Kraus et al. (2016). As shown, sensors RI-1, RI-2, and RI-3 effectively surround the SFWF, whereas the remaining sensor locations are in the more seaward portion of the WEA. 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 on the western side of the SFWF 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) are the dominant sources of underwater noise in the action area.

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. 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.

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.

Marine ecosystems are described using the Coastal and Marine Ecological Classification Standard (CMECS), a classification system based on biogeographic setting for the area of interest (FGDC 2012). CMECS provides a comprehensive framework for characterizing ocean and coastal environments and living systems using categorical descriptors for physical, biological, and chemical parameters relevant to each specific environment type (FGDC 2012). The CMECS biogeographic setting for the WDA is the Temperate Northern Atlantic Realm, Cold Temperate Northwest Atlantic Province, Virginian Ecoregion. The biotic component of CMECS classifies living organisms of the sea floor and water column based on physical habitat associations across a range of spatial scales. This component is organized into a five-level branched hierarchy: biotic setting, biotic class, biotic subclass, biotic group, and biotic community. The biotic subclass is a useful classification category for characterizing the aquatic ecosystem. Biotic component classifications in the WDA are defined by the dominance of life forms, taxa, or other classifiers observed in surveys of the site. In the case of photos, dominance is assigned to the taxa with the greatest percent cover in the photo (FGDC 2012).

The cable corridor is located in coastal marine waters where available water quality data are also limited. The EPA classified coastal water quality conditions nationally for the 2010 National Coastal Condition Assessment (EPA 2016). 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). This survey included four sampling locations near the WDA, all of which were within Block Island Sound. EPA (2016) rated all National Coastal Condition Report parameters in the fair to good categories at all four of these locations.

The WDA is located in temperate waters and, therefore, subjected to highly seasonal variation in temperature, stratification, and productivity. Overall, pelagic habitat quality within the WFA and offshore components of the cable corridor is considered fair to good (USEPA 2015). Baseline conditions for water quality are further described below. Section 4.2.4 of the COP details oceanographic conditions in the WFA and surrounding area. Circulation patterns in the Lease Area and vicinity are influenced by water moving in from Block Island Sound and the colder water coming in from the Gulf of Maine with a net transport of water from Rhode Island Sound towards the southwest and west. While the net surface transport is to the southwest and west, bottom water may flow toward the north, particularly during the winter (Rhode Island Coastal Resources Management Council [RI CRMC] 2010).

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 (EPA 2012). 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 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. 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. 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 New England Wind' 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. All effects of these collective actions on ESA-listed species and designated critical habitat are, therefore, comprehensively analyzed in this Opinion.[33]

The purpose of the New England Wind project is to generate electricity. Electricity will travel from the WTGs to the ESPs and then by submarine cable to on-land cables in Massachusetts. As described in the COP, from this point, electricity generated at the WTGs would be distributed into the electrical grid from the onshore substations. 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 New England Wind project specifically. Because the electricity generated by New England Wind 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 New England Wind's 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

[33] The term "proposed action" or "action" may be used to refer to all action agencies' actions related to the New England Wind project, unless specific context reveals otherwise.

generated by the New England Wind 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 in the action area. Effects to critical habitat were addressed in section 4 of this Opinion. 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 affects listed species, establish the underwater noise that listed species are likely to be exposed to, 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 foundation installation (vibratory and impact pile driving and drilling), detonations of UXO/MEC, 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 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 based on information provided to us by the action agencies. More detailed information is presented in the acoustic reports produced for the project (JASCO 2023 which is a December 2023 updated version of COP Appendix III-M); New England Wind's Application for an ITA and update memos[34] including the January 2024 LOA Update Memo, the Proposed Rule prepared for the MMPA ITA (88 FR 37606; June 8, 2023 also referred to here as the proposed MMPA ITA), and BOEM's BA, as updated in December 2023.

Installation of WTG and ESP Foundations

Through conditions of COP approval and the proposed MMPA ITA, the installation of WTG and ESP foundations, inclusive of relief drilling and vibratory and impact pile driving, 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 Schedule A) to three (Construction Schedule B) construction seasons. During this period, up to 132 foundations will be installed. All WTG and ESP foundations for phase 1 will be monopiles (12 or 13 m diameter) or jackets (four 4-m diameter pin piles), all WTG foundations for phase 2 will be monopiles (12 or 13 m diameter), jacket (four 4-m diameter pin piles each or suction buckets), or bottom-frame foundations (with piles or suction buckets); the phase 2 ESPs will be installed on monopile or jacket foundations (piles or suction bucket). For the acoustic modeling that informs our effects analysis (JASCO 2023), Schedule A considers that 89 monopile foundations and two jacket foundations are installed in year 1 and up to 18 monopiles and 24 jacket foundations are installed in year 2. Schedule B is spread over 3 years where 55 monopiles and three jacket foundations would be installed in year 1, 53 jacket foundations would be installed in year 2 and 22 jacket foundations would be installed in year 3. In years 2 and 3 of Schedule B, jacket foundations are assumed for all positions because they provide a conservative envelope for any of the assessed monopile foundations, up to and including a 13 m diameter monopile with a 6000 kJ hammer. At this time, foundation installation is expected to commence no sooner than May 1, 2026.

Installation of monopile and piled jacket foundations will involve impact pile driving of all foundations with some piles also requiring vibratory pile setting (preceding impact pile driving) and/or drilling to facilitate penetration through difficult soils or boulders (more information below). Considering the potential for some foundations in phase 2 to be installed on suction bucket foundations, the total number of foundations to be installed with impact pile driving may be less than 132. For all construction scenarios, one or two monopiles or one

[34] Available at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-park-city-wind-llc-construction-new-england-wind-offshore-wind

jacket foundation (four pin piles) would be installed per day; no concurrent pile driving is proposed.

Monopiles would be installed using a 5,000 kJ to 6,000 kJ hammer to a maximum penetration depth of 40 m (131 ft). Park City estimates that a monopile could require up to 6,970 strikes at up to 30.0 blows per minute (bpm) to reach full penetration depth. It is expected that each monopile installation will last less than 6 hours, with most installations anticipated to last between 3–4 hours; based on the hammer schedule, impact pile driving would occur for just under 4 hours. One or two monopiles will be installed per day with no overlapping or concurrent pile driving. Jacket foundations would be installed using a 3,500 kJ hammer to drive 4-m pin piles to their maximum penetration depth of 50 m (164 ft). There are four pin piles per jacket foundation; Park City estimates that each pin will take up to 9,805 hammer strikes at up 30.0 bpm to reach full penetration depth for about 5.4 hours of pile driving. The WTG jacket piles are expected to be pre-piled (*i.e.,* the jacket structure will be set on pre-installed piles). Up to three ESP jackets are expected to be post-piled (*i.e.,* the jacket is placed on the seafloor and piles are subsequently driven through guides at the base of each leg). The bottom-frame foundation (for Phase 2 only) is similar to the jacket foundation, with shorter piles and shallower penetration. As described in the proposed MMPA ITA, the potential acoustic impact of the bottom-frame foundation installation is equivalent to or less than that predicted for the jacket foundation. We agree with this determination and consider the analysis presented below for the jacket foundations to also apply to bottom-frame foundation installation.

Park City has determined that it may be necessary to start pile installation using a vibratory hammer rather than using an impact hammer, a technique known as vibratory setting of piles. The vibratory method is anticipated for use when soft seabed sediments are not sufficiently stiff to support the weight of the pile during the initial installation, increasing the risk of `pile run' where a pile sinks rapidly through seabed sediments. Piles which experience pile run can be difficult to recover and pose significant safety risks to the personnel and equipment on the construction vessel. The vibratory hammer mitigates this risk by forming a hard connection to the pile using hydraulic clamps, thereby acting as a lifting/handling tool as well as a vibratory hammer. The tool is inserted into the pile on the construction vessel deck, and the connection made. The pile is then lifted, upended and lowered into position on the seabed using the vessel crane. After the pile is lowered into position, vibratory pile installation will commence.

Vibratory pile installation is a technique where piles are driven into soil using a longitudinal vibration motion. The vibratory hammer installation method can continue until the pile is inserted to a depth that is sufficient to fully support the structure, and then the impact hammer can be positioned and operated to complete the pile installation. Of the 132 WTG/ESPs, Park City estimates approximately 70 total foundations may require vibratory hammering before impact hammering. The average expected duration of vibratory setting is approximately 30 minutes per pile.

As described in the proposed MMPA ITA, drilling is a contingency measure that may be required to remove soil and/or boulders from inside the pile in cases of pile refusal during installation. Pile refusal can occur if the total frictional resistance of the soil becomes too much for the structural integrity of the pile and the capability of the impact hammer. Continuing to drive in a refused condition can lead to overstress in the pile and potential to buckle (tear) the pile material. The use of an offshore drill can reduce the frictional resistance by removing the material from inside the pile and allowing the continuation of safe pile driving. An offshore drill is an equipment piece consisting of a motor and bottom hole assembly (BHA). The drill is placed on top of the refused pile using the construction vessel crane, and the BHA is lowered down to the soil inside the pile. On the bottom face of the BHA is a traditional "drill bit," which slowly rotates (at 4 or 5 revolutions per minute or approximately 0.4 m per hour) and begins to disturb the material inside the pile. As the disturbed material mixes with seawater which is pumped into the pile, it begins to liquefy. The liquefied material is pumped out to a pre-designated location, leaving only muddy seawater inside the pile instead of a solid "soil plug," and largely reducing the frictional resistance generated by the material inside the pile. When enough material has been removed from inside the pile and the resistance has reduced sufficiently, the drill is then lifted off the pile and recovered to the vessel. The impact hammer is then docked onto the pile and impact pile driving commences. It may be necessary to remove and replace the drill several times in the driving process to achieve sufficiently low frictional resistance to achieve the design penetration through impact pile driving. Of the 132 WTG/ESPs, Park City estimates 48 foundations may require drilling to remove soil and/or boulders from inside the pile that would otherwise affect the capability of the impact hammer.

While pre-piling preparatory work and post-piling activities could be ongoing at one foundation position as pile driving is occurring at another position, there is no concurrent/simultaneous pile driving of foundations planned. Drilling, vibratory and impact pile driving associated with foundation installation would be limited to the months of May through December and is currently scheduled to be conducted during 2026–2028.

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 clearance and shutdown zones and ensuring adequate visibility for monitoring.

In order for Park City to initiate pile driving after dark, as required by the proposed MMPA ITA and described in the BA as a proposed condition of COP approval, Park City will need to prepare, and receive approval from BOEM and NMFS (OPR and GARFO), on a night time pile driving monitoring plan. To date, Park City 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 Park City to initiate pile driving during daylight hours unless there is an approved Alternative

Monitoring Plan (also referred to as a Low or Reduced Visibility Monitoring Plan, which is expected to be a component of the Pile Driving and Marine Mammal Monitoring Plan). This plan would need to be developed by Park City and include an explanation of 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 marine mammals in the identified clearance and shutdown zones. The plan will need to 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 will also 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.

Park City will employ a noise attenuation system during all pile driving and drilling associated with foundation installation. 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. Park City 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 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 and must be in place and effective during impact pile driving, drilling, and vibratory pile setting. As such, Park City, 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 and vibratory pile driving and drilling for foundation installation.

Consistent with the requirements of the proposed MMPA ITA, the noise attenuation system would consists of at least two noise abatement systems, such as a double bubble curtain or single bubble curtain and an encapsulated bubble or foam sleeve. 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 and drilling 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 (SFV) 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 of sea turtles and 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 (see Appendix A and B). 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 that distances to these thresholds of concern as modeled can be met through SFV could lead to the need for reinitiation of 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, Park City would be required to maintain the following operational parameters for bubble curtains (single or double): 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. Park City also 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 Park City 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 bubble curtain and another noise abatement system or a double bubble curtain. NMFS OPR has reached the same conclusion, as described in the proposed MMPA ITA. Based on our independent review of the available information, we agree with that determination provided that the system is deployed properly and regular maintenance is carried out between deployments; we note that this presumption will be verified through the required SFV. 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 given variability, 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.

Park City carried out acoustic modeling to estimate sound fields that will be produced during foundation installation (drilling, vibratory pile setting, impact pile driving) and to estimate exposures of marine mammals and sea turtles to noise above identified thresholds (JASCO 2023, COP Appendix III-M, as noted above this was updated in December 2023). A full summary of modeling, including source and sound propagation is provided in the proposed MMPA ITA and JASCO 2023. 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. 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 Park City would conduct the majority, if not all of its foundation installation work. For vibratory pile driving and drilling during foundation installation, Park City assumed a simple practical spreading loss (15logR).

As described in JASCO 2023, sounds produced by installation of the proposed monopiles were modeled at two sites (M1 and M2) for the 12-m diameter monopile foundations, M1 in the northwest section of the WDA in 44 m water depth and M2 in the southeast section of the WDA at 52 m water depth. Acoustic propagation modeling was conducted for 4-m diameter jacket foundation piles assuming a site in the central area of the WDA at 53 m water depth. Modeling locations are shown in Figure 7 of the ITA application. These locations were chosen based on the phasing plans of the Project, which involves the installation of 12-m diameter monopiles in

Phase 1 and 13-m diameter monopiles in Phase 2, with jacket foundations planned for both phases. The 13-m diameter piles were only considered for modeling of the source functions for comparison with the 12-m diameter piles, which showed minimal difference in the forcing function and source spectra output for the two sizes. As the 12-m monopile represents the maximum size monopile for Phase 1 of the Project and the average size monopile for Phase 2, with only minimal differences in sound fields, propagation modeling continued with the 12 m monopile.

Key modeling assumptions for the monopiles and pin piles are listed in Table 10 of the proposed MMPA ITA (Table 7.1.1 below). Hammer energy schedules for monopiles (12-m) and pin piles (4-m) are provided in Table 8 of the proposed MMPA ITA (Table 7.1.2 below). Within these assumptions, both pre-piled and post-piled jacket foundations were considered.

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	6,000	200	95	40	1-2
4-m Pin Pile for Jacket Foundation	3,500	100	100	50	4

Notes: A 12-m monopile using 6,000 kJ was considered representative of the other monopile approaches as the 13-m is unlikely to occur. Jacket foundations each require the installation of three to four jacket securing piles, known as pin piles. The bottom-frame foundation is similar to the jacket foundation, with the same maximum 4-m pile diameter, but with shorter piles and shallower penetration and was therefore not modeled separately in the acoustic assessment. It is assumed that the potential acoustic impact of the bottom-frame foundation installation is equivalent to or less than that predicted for the jacket foundation.
source: Table 10 in the Proposed MMPA ITA

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

12-m monopile 5000 kJ hammer		13-m monopile 5000 kJ hammer		12-m monopile 6000 kJ hammer		4-m pin pile 3500 kJ hammer		13-m monopile 6000 kJ hammer[1]	
Energy Level (kJ)	Strike Count	Energy Level (kJ)	Strike Count	Energy Level (kJ)	Strike Count	Energy Level (kJ)	Strike Count	Energy Level (kJ)	Strike Count
1,000	690	1,000	745	1,000	750	525	875	1,000	850

1,000	1,930	1,000	2,095	2,000	1,250	525	1,925	2,000	1,375
2,000	1,910	2,000	2,100	3,000	1,000	1000	2,165	3,000	1,100
3,000	1,502	3,000	1,475	45,000	1000	3,500	3,445	4,500	1,100
5,000	398	5,000	555	6,000	500	3,500	1,395	6,000	550
Total	6,430	Total	6,970	Total	4,500	Total	9,805	Total	4,975
Strike Rate	30.0 bpm	Strike Rate	30.0 bpm	Strike Rate	25.0 bpm	Strike Rate	30.0 bpm	Strike Rate	27.6 bpm

1- Due to the unlikely event Park City installs a 13-m pile with a 6,000 kJ hammer, source levels were modeled to estimate the distances to mitigation zones; however, exposure modeling was not conducted for this scenario.
source: Table 11 in Proposed MMPA ITA

The modeling approach for vibratory pile driving and drilling is described in the proposed MMPA ITA and JASCO 2023. Resulting source levels assuming 10-dB attenuation from use of noise abatement (*e.g.,* double bubble curtain) can be found in Table 13 in the MMPA proposed rule (Table 7.1.3 below).

Table 7.1.3. Assumed Source Levels For Vibratory Pile Driving and Drilling of Foundation Piles

Activity	Source Level SEL	Source Level SPL
Vibratory driving (13-m piles)	188 dB[1]	190.5 dB
Drilling	N/A	183.3 dB[2]

1- Extrapolation of data resulted in a source level (SEL) of 198 dB.
2- Source level reported in Austin *et al*. (2018) is 193.3 dB SPL, based on a measured received level of 141.8 dB at 1 km.
source: Table 13 in MMPA proposed rule

After calculating source levels, Park City 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 F in Park City's 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 regulatory 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 (JASCO 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 Park City and BOEM to consider exposure of sea turtles above the cumulative injury threshold.

Park City 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; in contrast to exposure range which 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 is an instantaneous exposure, acoustic ranges are reasonable to use when considering these thresholds. Because information is not available to support animat modeling for Atlantic sturgeon, acoustic ranges were also used by Park City and BOEM when considering exposure of Atlantic sturgeon to noise above the identified thresholds.

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

UXO/MEC Detonation
As described in section 3.0, the proposed action includes the detonation in place of up to 10 UXO/MECs (for ease of reference, referred to generically as UXO here) with up to 454 kg (1,000 pounds) charges, which is the largest charge that is reasonably expected to be present. As described by BOEM, Park City, and NMFS OPR, while the specific charges of all 10 UXOs are unknown, it is reasonable to expect that all 10 could consist of this 454 kg charge. Any detonations would occur on up to 10 different days (i.e., only one detonation would occur per day) during daylight hours only between May 1 and December 31. It is anticipated that these detonations would occur across two years (up to six in 2025 and up to four in 2026).

Modeling of acoustic fields for UXO detonations in the MA/RI WEA was carried out (Hannay and Zykov 2022), which included three sound pressure metrics (peak pressure level, SEL, and acoustic impulse), four different depths at four different sites, and five charge weight bins ranging from 5 pounds (2.3 kg) (bin E4) up to 1,000 pounds (454 kg) (bin E12). The depths were selected to be representative of the lease area and cable route and ranged from 39 to 148 feet (12 to 45 meters). The modeling of acoustic fields was performed using a combination of semi-empirical and physics-based computational models. The modeling assumed that the full weights of UXO explosive charges are detonated together with their donor charges and that no shielding by sediments occurs. It also assumed that only one UXO would be detonated within a 24-hour period. Modeling of mitigated (10 dB attenuation) and unmitigated scenarios were conducted; however, mitigation will be required for all detonation events (10 dB attenuation will be required as a condition of COP approval and the proposed MMPA ITA). As described in the proposed ITA, the locations were deemed to be representative of both the export cable route and the lease area.

Park City is committing to use of a dual noise-mitigation system during all detonations; this will also be required by BOEM and NMFS OPR. Based on the available literature, 10 dB minimum of attenuation is possible with the use of a noise mitigation system (review provided in Hannay and Zykov 2022), and Park City has committed to attaining a 10 dB attenuation for all UXO detonation events. As described in section 3.0 of this Opinion, in addition to seasonal and time of day restrictions as well as 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 UXO detonations, including extensive monitoring of clearance zones. These are discussed in detail in the Effects Analysis below. We also note that detonation will only occur if all other alternatives are exhausted (e.g., avoidance, relocation, etc.).

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 New England Wind project are expected to be similar in frequency and source level.

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.

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, 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. 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 above 120 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. 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 paper to the New England Wind 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 height of turbines becomes greater with larger capacity, the distance from the noise source in the nacelle to the water becomes greater 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 New England Wind 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 New England Wind 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.

The WTGs proposed for New England Wind will use the newer, direct-drive technology. Elliot et al. (2019) is the only available data on in-situ measurements of underwater noise from operational direct-drive turbines. 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 New England Wind 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) to represent the best available data on operational noise that can be expected from the operation of the New England Wind turbines. We acknowledge that as the New England Wind turbines will have a greater capacity (up to 15 MW) than the turbines at Block Island 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 New England Wind 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.

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 New England Wind WFA (COP Appendix III-1)), which is summarized in Table 7.1.4 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 7.1.4. 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. Based on wind speed records in the lease area (COP Appendix III-I), wind speeds are typically up to 30 km/h. As indicated by data from the nearby Buzzards Bay Buoy maintained by NOAA's National Data Buoy Center (BUZM3; November 2008 – April 2023), average wind speed is 27 km/h with average gusts of 30 km/h; 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 6% of the time across a year[35].

[35] https://www.ndbc.noaa.gov/station_page.php?station=BUZM3

Table 7.1.5. Summary of unweighted SPL RMS average sound levels (10 Hz to 8 kHz) measured at 50 m (164 ft.) from WTG 5

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

High-Resolution Geophysical Surveys
As part of the proposed action for consultation in this opinion described in Section 3, Park City plans to conduct HRG surveys in the WDA, including along the export cable routes to landfall locations in Massachusetts intermittently through the construction and operation periods. Geophysical survey instruments may include side scan sonar, synthetic aperture sonar, single and multibeam echosounders, sub-bottom profilers (SBP), and magnetometers/gradiometers. Equipment may be mounted to the survey vessel or the Project may use autonomous surface vehicles (SFV) to carry out this work. Surveys would occur annually, with durations dependent on the activities occurring in that year (i.e., construction years versus operational years), with approximately 25 survey days per year anticipated.

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 New England Wind 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 Park City 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 New England Wind 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 7.1.6 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 7.1.6 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)
Boomer	Applied Acoustics AA251	0.2-15	205	212	0.8	2
Sparker	GeoMarine GeoSpark 2000 (400 tip), SIG ELC 820 Sparker	0.05-3	203	213	3.4	1

source: Table 3 in the Proposed MMPA ITA

The boomer and sparker 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 37606; June 8, 2023) presents extensive information on the potential effects of underwater sound on marine mammals; that information is the best scientific information available on the 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. Animals experiencing PTS or TTS will also likely experience some level of behavioral disturbance... 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, are often fully recoverable, 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[36]). 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 and note it is used to inform the proposed MMPA ITA.

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

Table 7.1.7. 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[37]	Permanent Threshold Shift Onset[38]	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 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

[37] 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).

[38] *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 ($_{24h}$)

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.

Explosives Source Thresholds
As described in the Notice of Proposed MMPA ITA, based on the best scientific information available, NMFS uses the acoustic and pressure thresholds indicated in Table 7.8 below (Table 9 in the proposed MMPA ITA) to predict the onset of PTS and TTS during UXO/MEC detonation. For a single detonation (within a 24-hour period), NMFS relies on the TTS onset threshold to assess the potential for Level B harassment.

Table 7.1.8 PTS onset, TTS onset, for underwater explosives (NMFS, 2018)

Hearing Group	PTS Impulsive Thresholds	TTS Impulsive Thresholds
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{pk,flat}$: 213 dB $L_{E,LF,24h}$: 168 dB
Mid-Frequency (MF) Cetaceans	*Cell 4* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 5* $L_{pk,flat}$: 224 dB $L_{E,MF,24h}$: 170 dB

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

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

Additional thresholds for non-auditory injury to lung and gastrointestinal (GI) tracts from the blast shock wave and/or onset of high peak pressures are also relevant (at relatively close ranges) as UXO/MEC detonations, in general, have potential to result in mortality and non-auditory injury (Table 7.9, Table 10 in the MMPA ITA). Marine mammal lung injury criteria have been developed by the U.S. Navy (DoN (U.S. Department of the Navy), 2017) and are based on the mass of the animal and the depth at which it is present in the water column due to blast pressure. This means that specific decibel levels for each hearing group are not provided and instead, the criteria are presented as equations that allow for incorporation of specific mass and depth values. The GI tract injury threshold is based on peak pressure. The modified Goertner equations below represent the potential onset of lung injury and GI tract injury.

Table 7.1.9 Lung and G.I. tract injury thresholds (DoN, 2017)

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

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

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

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

Equation 1: $103M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s

Equation 2: $47.5M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s

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

Definition of Harassment

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[39] on the term "harass," under the ESA, defining it as to "create the likelihood of injury

[39] NMFS Policy Directive 02-110-19; available at https://media.fisheries.noaa.gov/dam-migration/02-110-19.pdf;

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 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

Blue, 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 New England Wind project. As explained in section 3, NMFS OPR is proposing to authorize MMPA Level B harassment take of a number of blue, fin, sei, sperm, and right whales as a result of exposure to noise from foundation installation (vibratory and impact pile driving and drilling), UXO detonation, and HRG surveys and to authorize MMPA Level A take of a small number of blue, sperm, fin, and sei whales as a result of exposure to noise from foundation installation and/or UXO detonation. Park City 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 foundation installation, UXO detonation, 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.

In their MMPA ITA application and supplemental information, Park City estimated exposure of marine mammals (including ESA listed blue, 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; as explained above these were supplemented with updated reports in December 2023 and January 2024 which inform the analysis here.

last accessed November 15, 2023.

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[40]). We have independently evaluated and adopted OPR's analysis of the number of blue, fin, right, sei, and sperm whales expected to be exposed to foundation installation noise and UXO detonations 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 Park City's December 2023 updates. As noted throughout, there have been a number of corrections and updates that post-date the BA. Below we describe Park City's and NMFS OPR's exposure analyses for these species.

Acoustic Modeling

The Notice of Proposed ITA, BOEM's BA, and Park City's December 2023 (JASCO 2023) and January 2024 updated acoustic reports (JASCO 2024/LOA Update Memo), provide extensive information on the acoustic modeling prepared for the project. 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 during all foundation installation activities and UXO detonations; 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, Park City considered the buildout described for Construction Schedule A (89 monopile foundations and two jacket foundations installed in Year 1 and 18 monopile and 24 jacket foundations in Year 2) and Construction Schedule B (55 monopiles and three jacket foundations in Year 1, 53 jacket foundations in Year 2, and 22 jacket foundations in Year 3). Exposure modeling incorporated the 12-m monopiles installed with a 6,000 kJ hammer and 4-m jacket piles with the 3,500 kJ hammer. NMFS OPR is proposing to authorize a total amount of take considering Construction Schedule B as those take estimates are greater than Construction Schedule A (as there are more days of pile driving for jacket foundations). If suction bucket foundations are installed during Phase 2, this would reduce the amount of drilling and pile driving.

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 7.1.7). 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

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

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 4 hours of impact pile driving to install a monopile); this contrasts to exposure range which models the "closest point of approach".

As explained above, 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 (JASCO 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 New England Wind (JASCO 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.

Park City 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 typically considers acoustic ranges ($R_{95\%}$) to the Level A harassment SELcum metric thresholds to be very 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. As noted in the proposed MMPA ITA, because animat modeling was not conducted for vibratory pile driving or drilling, acoustic range is used to assess Level A harassment (dB SEL) for vibratory pile driving and drilling. The differences between exposure ranges and acoustic ranges for Level B harassment are minimal given it is an instantaneous method.

Park City considered both the 12 m and 13 m monopiles for the acoustic source modeling; as explained in the proposed MMPA ITA, the initial source modeling showed minimal difference between the 12 m and 13 m monopiles installed with a 6,000 kJ hammer. Therefore, Park City modeled, and OPR based their proposed take, based on the 12-m monopile installed with the 6,000 kJ hammer. Exposure modeling considered all foundations in Phase 1 were monopiles and all foundations in Phase 2 were jackets. In the proposed MMPA ITA, NMFS OPR considers the relevant exposure and acoustic ranges to Level A harassment 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. 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% km) for impact pile driving of a 12-m monopile, 13-m monopile, and 4-m pin pile jacket foundations, assuming 10 dB of sound attenuation to the PTS (SEL) thresholds are presented in the table below.

Table 7.1.10 Exposure Ranges ($ER_{95\%}$) in Kilometers to Marine Mammal Level A and Level B Harassment Thresholds during Impact Pile Driving Only, Assuming 10 dB Attenuation

Species	12 m monopile, 6,000 kJ hammer						4-m jacket		
	1 pile/day			*2 pile/day*			*4 piles/day*		
	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior
Fin whale	<0.01	2.05	5.28	0	2.16	5.29	<0.01	3.73	4.66
North Atlantic right whale	0	1.19	4.91	0	1.34	4.83	0	2.35	4.54
Sei whale	0	1.36	5.19	0	1.27	5.17	<0.01	2.10	4.52
Sperm whale	0	0	5.22	0	0	5.16	0	0	4.52

source: Tables 16, 17 and 22 in JASCO 2024 (LOA Update Memo)

As described above, New England Wind also calculated exposure ranges for vibratory setting only and vibratory setting followed by impact pile driving. The tables below present the modeled distances to the Level A and Level B thresholds for vibratory setting alone (Table 7.1.11) and vibratory setting followed by impact pile driving (Table 7.1.12).

Table 7.1.11 Exposure Ranges ($ER_{95\%}$) in Kilometers to Marine Mammal Level A and Level B Harassment Thresholds during Vibratory Pile Driving Only, Assuming 10 dB Attenuation

Species	12 m monopile, 6,000 kJ hammer						4-m jacket		
	1 pile/day			*2 pile/day*			*4 piles/day*		
	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior
Fin whale	0	0.02	22.22	0	0	22.14	0	0.04	27.74
North Atlantic right whale	0	0	20.96	0	0	21.10	0	0	25.66
Sei whale	0	0	22.30	0	0	22.08	0	0	28.05
Sperm whale	0	0	21.97	0	0	21.95	0	0	27.11

source: Tables 25, 26, 31, 34, 35, and 40 in JASCO 2024 (LOA Update Memo)

Table 7.1.12 Exposure Ranges ($ER_{95\%}$) in Kilometers to Marine Mammal Level A and Level B Harassment Thresholds for Piles Installed with Vibratory Setting Followed by Impact Pile Driving, Assuming 10 dB Attenuation (distance above the Behavioral threshold for vibratory period is in table above, distance for behavior below is for impact period)

Species	12 m monopile, 6,000 kJ hammer						4-m jacket		
	1 pile/day			*2 pile/day*			*4 piles/day*		
	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior	Level A peak	Level A SEL	Behavior
Fin whale	<0.01	2.14	5.30	0	2.24	5.31	<0.01	4.02	4.63
North Atlantic right whale	<0.01	1.39	4.91	0	1.44	4.83	0	2.44	4.47
Sei whale	0	1.64	5.21	0	1.26	5.24	<0.01	2.16	4.56
Sperm whale	0	0	5.17	0	0	4.31	0	0	4.54

source: Tables 25, 26, 31, 34, 35, and 40 in JASCO 2024 (LOA Update Memo)

Acoustic ranges to injury and behavioral thresholds (120 dB re 1uPa SPL) anticipated during drilling to assist foundation installation were modeled for three locations (Table 7.1.13).

Table 7.1.13 Acoustic Ranges ($R_{95\%}$), in Kilometers, to PTS (L_{pk}) and Behavioral Thresholds during Drilling, with10 dB Attenuation

Marine Mammal Species	Modeled Source Location	PTS (cumulative, 24/hour)	Behavior
LFC: blue, fin, right, sei whale	J1	0.0507	7.054
	M1	0.065	6.853
	M2	<0.05	6.884
MFC: sperm whale	L01	0	7.054
	L02	0	6.853
	M2	0	6.884

source: Table 44-46 and Tables 50-52 in JASCO 2024 (LOA Update Memo)

To estimate the number of individuals of each marine mammal species that may be exposed to noise above the identified thresholds, Park City conducted exposure modeling to estimate the number of exposures that may occur from drilling, vibratory pile setting, and impact pile driving in a 24-hour period. Exposure estimates were then scaled to reflect the density estimates derived from Roberts et al. 2022. These scaled 24-hour exposure estimates were then multiplied by the number of days of the relevant activity (i.e., relief drilling, impact pile driving only, vibratory setting followed by impact pile driving) to produce the estimated take numbers for each year. As density in the WDA is too low to support exposure modeling, for estimating exposure of blue whales above the Level A and Level B harassment threshold, Park City considered average group size and based on the rarity of blue whales in the WDA and surrounding waters anticipated that exposure of a group could occur every year; as such, considering that there could be 3 years of foundation installation, Park City requested authorization for the take of 6 blue whales, 2 by Level A harassment and 4 by Level B harassment. NMFS OPR concurred with this analysis and is proposing to authorize this amount of take.

The total exposure estimates, by species, for each of the two construction seasons, is presented in Table 7.1.12 and 7.1.13 below. The total amount of take proposed by OPR for authorization (based on Construction Schedule B and for level A take of right whales only, considering proposed mitigation measures) is summarized in Table 7.1.14.

Table 7.1.12 Exposure Estimates: Level A Harassment and Level B Harassment for Vibratory and Vibratory plus Impact

Marine Mammal Species				
	Construction Schedule A		**Construction Schedule B**	
	Level A Harassment	**Level B Harassment**	**Level A Harassment**	**Level B Harassment**
Blue Whale*	2	4	2	4
North Atlantic right whale	3	51	6	74
Fin whale	14	262	33	349
Sei whale	3	32	6	50
Sperm whale	0	77	0	97

*blue whale exposures are based on group size and estimated frequency of exposure
source: JASCO 2024 Updated LOA Memo

Table 7.1.13 Exposure Estimates: Level A Harassment and Level B Harassment for Drilling (Note that duplicates are not removed in this table)

Marine Mammal Species	**Drilling**			
	Construction Schedule A		**Construction Schedule B**	
	Level A Harassment	**Level B Harassment**	**Level A Harassment**	**Level B Harassment**
Blue Whale	0	0	0	0

North Atlantic right whale	0	5	0	5
Fin whale	0	23	0	23
Sei whale	0	4	0	5
Sperm whale	0	6	0	5

source: JASCO 2024 Updated LOA Memo

NMFS OPR proposes to authorize the f the harassment of marine mammals incidental to foundation installation activities of WTG and ESPs by Level A harassment and Level B harassment as described in Table 7.1.14. On the days with overlap between drilling and vibratory hammering, the estimated Level B takes resulting from drilling were not included to avoid double counting taken animals, because all animals within the larger vibratory hammering zone of influence were assumed to have already been taken by that activity. We note that Park City 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 Park City would be required to implement for this species.

Table 7.1.14 Incidental Take by Level A Harassment and Level B Harassment Proposed for MMPA Authorization for All Foundation Installation Activities (Construction Schedule B)

Marine Mammal Species	All Foundation Installation Activities	
	Construction Schedule B	
	Level A Harassment	Level B Harassment
Blue Whale	2	4
North Atlantic right whale	0	74
Fin whale	33	352
Sei whale	6	49
Sperm whale	0	96

source: NMFS OPR, February 2024 based on JASCO 2024 Updated LOA Memo

We note that Park City 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). Park City requested the take of blue whales based on group size (see table 14 in the MMPA proposed rule) and anticipated rarity of occurrence in the WDA which suggests exposure would not be likely more than once every year (total of 6 exposures). 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 Park City 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 Foundation Installation Activities

No foundation installation activities (drilling, vibratory or impact hammering) would occur between January 1 and April 30 to avoid the time of year with the highest densities of right whales in the WDA. Additionally, per conditions of the proposed MMPA ITA, no vibratory pile setting would occur in May or December. 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 foundation installation 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 foundation installation activities (drilling, impact and vibratory pile driving), New England Wind would implement sound attenuation technology that would achieve at least a 10 dB reduction in pile driving or drilling 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 7.1.10-7.1.13); 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 installation) are to ensure that Park City 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 Park City's initial drilling and 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 installed.

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 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 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).

Through conditions of the proposed ITA and conditions of the proposed COP approval, Park City will conduct sound field verification for at least the first three monopiles and the first two full jacket foundations (inclusive of all pin piles for each foundation). Park City 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 or installation methodology suggests that noise will be louder than piles for which SFV was already carried out (e.g., larger piles, 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 two 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 monopiles or first two jackets indicate that the ranges to Level A harassment or Level B harassment isopleths are larger than those modeled, assuming 10-dB attenuation, Park City 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, Park City 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, Park City 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 7.1.15). In addition to the clearance and shutdown zones, OPR will include a requirements for a minimum visibility distance before foundation installation, inclusive of drilling, impact pile driving, and vibratory pile setting, can begin (2,100 m for monopiles, 3,400 m for jackets; as explained by NMFS OPR these distances were determined by rounding up from the largest distance to the Level A harassment threshold for low frequency cetaceans, not including fin whales). This is the distance from the observation platform 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 smaller than the shutdown and clearance zone for large whales; however, when considering that there will be PSOs on at least two platforms (3 PSOs on the pile driving platform and 3 PSOs on a dedicated PSO vessel, as required by the proposed MMPA ITA) 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. For example, considering the 2,100 m minimum visibility distance for monopiles 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 4 km (i.e., 2,100 m from the pile driving platform plus an additional 2,100 m from a vessel located approximately 2 km from the pile); this is larger than the 3.3 km clearance zone for large whales for monopile installation.

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 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 visibility zone that the visual observers can see. For example, if a right whale is observed at a distance of 6 km from a monopile that is ready to be installed, pile driving would be delayed. 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. The PAM monitoring system will be designed to detect vocalizing marine mammals located within 12 km of the pile. Pile driving cannot commence until all of these clearances are made. For monopiles, considering the 3.3 km clearance zone for blue, fin, and sei whales, the clearance zone is 1-2 km larger than the modeled distances to the ER95% for Level A cumulative threshold (Table 7.1.10-7.1.13) for all daily pile installation scenarios; the clearance zone is smaller than the modeled distance to the Level B threshold for all installation scenarios. For right whales, considering just the 4 km distance that PSOs are expected to be able to monitor in all conditions (based on the 2.1 km minimum visibility requirement from at least 2 PSO platforms), the clearance zone is over 2.5 km larger than the modeled distance to the ER95% for Level A cumulative threshold. Similar conclusions are reached for pin piles; considering the 4.9 km clearance zone and the 3.4 km minimum visibility zone, the clearance zone exceeds the modeled distance to the Level A cumulative threshold by at least 1km for blue, fin, and sei whales and at least 1.7 km for right whales (considering just a 4km visibility for the PSOs), with the distance to the Level B threshold larger than the clearance zone. We note that the distance to the level A (peak and cumulative) for sperm whales is not exceeded in any pile installation scenario and for other large whales, including right whales, is not exceeded at any distance greater than 65 m for drilling, which would require a whale to remain within that distance from the pile for 24-hours). We note that OPR may make additional modifications to these zone sizes in the MMPA final rule. These measures are addressed further below.

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 Park City 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 12 km distance from the pile that will be monitored by PAM. The shutdown zones, as revised by OPR during the consultation period (see Table 7.1.15) are larger than the modeled distances to the ER95% for Level A cumulative threshold (Table 7.1.10-7.1.13) for all pile installation scenarios. The shutdown zone is smaller than the distance to the Level B harassment threshold for drilling, vibratory pile setting, and impact driving. We note that OPR may make additional modifications to these zone sizes in the MMPA final rule.

Table 7.1.15. 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. Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility zones. Detection (visual or PAM) of an animal within the clearance zone triggers a delay of initiation of pile driving; detection (visual or PAM) of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Monopile Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 2,100 m monopile; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM

Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	3,300 m (visual or PAM detection)	2,700 m (visual or PAM detection)
Jacket Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 3,400 m jacket foundations; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (3.4 km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM	At any distance (Minimum visibility zone (3.4km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM
Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	4,900 m (visual or PAM detection)	4,100 m (visual or PAM detection)

Note: The minimum visibility zone was set by NMFS OPR by rounding up from largest distance to Level A for LFC, not including fin whale: 2,070 m (humpback). The zones for monopiles apply for all impact pile driving, vibratory pile driving, and drilling activities and are based on the largest distances to Level A harassment thresholds across the monopile and hammer sizes *(i.e.*, 12m, 13m, 5,000 kJ, 6,000 kJ). Per the proposed MMPA ITA, the exact size may be modified through adaptive management should SFV demonstrate noise levels are lower than expected. New zones sizes will be based on the definition provided below. The zones for the 4-m jacket pin piles apply to impact pile driving, vibratory pile driving, and drilling activities and are based on the largest distances to Level A harassment thresholds. Per the MMPA ITA, the exact zone size may be modified through adaptive management should SFV demonstrate noise levels are lower than expected. New zones sizes will be based on the definition provided below. The clearance zone is based on the largest distance to the Level A harassment ER95% of the species group plus a 20% increase and then rounded up for PSO clarity. The shutdown zone is based on the largest distance to the Level A harassment ER95% of the species group rounded up for PSO clarity.

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 one dedicated PSO vessel. 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 blue, fin, sei, and sperm whales, this means that the PSOs have not seen any individuals within the relevant clearance zone (dependent on pile type and daily construction schedule) and the PAM operator must not have detected any vocalizations from those species within the relevant 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 in the PAM clearance zone (12 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.

The requirement for the minimum visibility zones for foundation pile driving and the requirement that PSOs be working from at least two platforms (3 PSOs at the pile driving platform, 3 on a vessel 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 daytime which is defined as being 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 foundation began during the day when clearance zones were fully visible; it was anticipated that foundation installation could be completed before sundown; and, foundation 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 or safety). In such cases, monitoring must be carried out consistent with an approved monitoring plan for low visibility conditions. Given that the time to install the pile is expected to be predictable, we expect these instances of pile installation taking longer than anticipated to be very rare.

As described above, unless a nighttime monitoring plan is approved by BOEM, NMFS OPR, and NMFS GARFO and that plan demonstrates that PSOs working after dark 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), drilling, vibratory or impact 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 foundation installation 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 foundation installation activities.

For foundation installation, 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 can be localized within 12 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. The PAM plan will need to 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 the identified PAM monitoring zone (12 km), 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 the monitoring zone (12 km; the area that the PAM system will need to be able to effectively monitor for vocalizing right whales), the appropriate associated clearance or shutdown procedures must be implemented (i.e., delay or stop the activity). 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 blue, fin, or sei whales in the identified clearance and shutdown zones (see Table 7.1.15 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 37606).

If an ESA listed whale is observed entering or within the identified shutdown zone (see Table 7.1.15) after drilling or pile driving has begun, a shutdown must be implemented. 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. Additionally, drilling or 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. If a marine mammal is observed entering or within the respective shutdown zone after drilling or pile driving has begun, the PSO will request a temporary cessation of the activity; similar requirements will be in place for PAM detections. In situations when shutdown is called for but New England Wind 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. Specifically, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal (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, drilling or 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 drilling or pile driving has been shut down due to the presence of a North Atlantic right whale, the activity 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 not expected to occur during drilling or vibratory pile setting and during impact pile driving would extend no further than 10 m from a pile being installed (Table 7.1.13). 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.

For monopiles, the proposed clearance zone (3.3 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), blue, fin, sei, and sperm whales; the maximum distance to the Level A cumulative threshold across all pile installation scenarios for those species is 1.44 km for right whales, 2.24 km for fin whales, 1.64 for sei (and blue) whales and 0 for sperm whales. Similarly, for pin piles, the proposed clearance zone (4.9 km) is larger than the exposure range to 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), blue, fin, sei, and sperm whales; the maximum distance to the Level A cumulative threshold across all pile installation scenarios for those species is 2.44 km for right whales, 4.02 km for fin whales, 2.16 for sei (and blue) whales and 0 for sperm whales. Drilling or pile driving cannot begin if a whale is detected by the visual PSOs within the clearance zone. 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 drilling or pile driving would begin with a whale within the clearance zone.

Modeling predicted the exposure of a small number of right, sei, blue, 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 and installations, the clearance zone is at least 1 km larger than the modeled closest point of approach for which exposure above the Level A threshold is exceeded for fin and sei whales (and by surrogate, blue whales). However, considering the modeled species-specific exposure ranges and the different pile types, the shutdown zone is only 80 – 650 m beyond the closest point of approach that modeling identifies as indicating a fin whale had accumulated enough noise exposure to experience PTS. The difference between the species-specific CPA for sei whales is larger than the shutdown zone; however in at least some pile driving scenarios the difference is only 1km. Given this, and considering the swim speeds of fin, sei, and blue whales (which are considerably faster than right whales – right whale maximum swim speed is around 9 km/h while the burst swim speeds of the other species ranges from 32-55 km/h), their deep and lengthy dives (which reduces surface time), and that shutdown may not be instantaneous (i.e., the PSO has to alert the lead engineer who then calls for a shutdown) and that in some rare cases shutdown may not be possible and the hammer energy will instead be reduced, the proposed shutdown requirements may not prevent all exposure of blue, fin, and sei whales to noise above the cumulative Level A harassment threshold. This was considered in the proposed authorization of the take of 2 blue, 33 fin, and 6 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 blue, fin, or sei whale in the clearance zone, given the factors outlined above, we cannot discount the potential for a blue, 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 Level A harassment threshold. Park City 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 given the factors identified above, we cannot discount all of the anticipated Level A exposures. However, we do expect that aversion (avoidance) behavior would reduce the number of actual exposures and that shutdown will be called for and implemented in time to avoid at least some of the remaining exposures; however, we are not able to develop an estimate of such an anticipated reduction in exposures. Therefore, we are not able to determine any reasonable reduction of the amount of take by Level A harassment (PTS) proposed for authorization by OPR that would be extremely unlikely to occur. Therefore, we consider that up to 2 blue, 33 fin, and 6 sei whales may be exposed to noise above the Level A harassment threshold and experience PTS as a result of impact pile driving noise.

Modeling predicts the exposure of fewer than 6 right whales above the cumulative Level A harassment threshold over the entire duration of all impact pile driving for foundation installation. The model does not consider the pre-start clearance or shutdown requirements or any aversion (avoidance) behavior of right whales. 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. 2022), 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 fewer than 6 right whales is for pile driving that is limited to May – December each year).

During foundation installation, PSOs and PAM will be used to monitor clearance and shutdown zones for right whales. For right whales, the minimum clearance and shutdown zone (considering only the 2.1 km minimum visibility zone from the pile driving platform for monopiles and 3.4 km minimum visibility zone for jackets) exceed the modeled distances to the cumulative Level A harassment threshold by 1 to 2 km; given the distances that we expect the visual PSOs to be able to monitor (at least 4 km considering the PSOs at the pile driving platform and on PSO vessels), the area that would be visually monitored is more than 2 km 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 2.44 km for the four pin piles installed in a single day with vibratory setting followed by impact driving; we expect the PSOs to be able to detect a right whale at least 4 km from these piles, which would be 1,560 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 12 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 12 km of the pile. We note that these measures (i.e., clearance and shutdown being triggered upon visual or PAM detection at any distance from the pile) are significantly more stringent than those imposed for other species. We also note that there are a number of other monitoring and reporting efforts for right whales in the area that the PSOs will need to monitor to increase situational awareness of any right whales in the area. Further, we note the slow swim speed and amount of time spent on the surface compared to other species which may increase the potential for detection by the PSOs compared to other whale species. Given this, we consider it extremely unlikely that a right whale would be close enough to a pile to experience PTS without a PSO 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. The slow swim speed of right whales makes it extremely unlikely that lower hammer energy could not be enacted before the whale reached the CPA. 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 (fewer than 6 individuals over the 2 to 3 foundation installation seasons), 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.

Given that the size of the area with noise above the Level B harassment threshold is larger than the clearance and shutdown zone (compare the distances in Table 7.1.15 to Table 7.1.10-7.1.13), the clearance and shutdown procedures may limit the duration of exposure of blue, 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 also note that given the size of the area where noise will be above the Level B harassment threshold, particularly during drilling (up to 7 km from the pile) and vibratory pile setting (up to 22 km from the pile) 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 4 blue, 74 right, 352 fin, 49 sei, and 96 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 expected 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. New England Wind 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., up to 1,200 KJ for monopiles, up to 700 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.

<u>Summary of Noise Exposure Anticipated as a Result of Foundation Pile Driving</u>
In summary, we expect that no ESA listed whales will be exposed to noise above the peak Level A harassment threshold; up to 2 blue, 33 fin, and 6 sei whales will be exposed to noise above the cumulative Level A thresholds during impact pile driving; and up to 4 blue, 74 right, 352 fin, 49 sei, and 96 sperm whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold during all foundation installation activities (drilling, vibratory and impact pile driving). Below, we consider the effects of these noise exposures.

7.1.3.2 Effects to ESA-Listed Whales from Exposure to Foundation Installation Noise
As explained above, we anticipate that during impact pile driving for foundations, up to 2 blue, 33 fin, and 6 sei whales will be exposed to noise above the cumulative Level A thresholds; and, and up to 4 blue, 74 right, 352 fin, 49 sei, and 96 sperm whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold during all foundation installation activities (drilling, vibratory and impact pile driving).

Effects of Exposure to Noise above the Level A Harassment Threshold
As explained above, up to up to 2 blue, 33 fin, and 6 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). 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 permanent 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 perform essential behavioral functions, such as foraging, socializing, migrating and communicating with conspecifics, or detecting environmental cues, i.e. 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. 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 MMPA ITA, and by BOEM through the conditions of COP approval, and implemented by Park City–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 or mortality. 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 New England Wind 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 up to 2 blue, 33 fin, and 6 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, forage 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 up to 4 blue, 74 right, 352 fin, 49 sei, and 96 sperm whales exposed to noise above the Level B harassment threshold but below the Level A harassment threshold 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 New England Wind' 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 16 hours a day (if four pin piles are installed in a single day and each requires 4 hours of pile driving), 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 New England Wind project noise are addressed more fully 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 16 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 74 North Atlantic right whales may experience TTS and/or behavioral disturbance from exposure to pile driving noise. As this exposure will occur over two to three years, this may be 74 different right whales or there could be some individuals exposed to pile driving noise in multiple years. We do not expect repeat exposures in a single construction season (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 during the May – December period when pile driving would occur. 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 during the time of year when pile driving will occur. 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 four hours at a time and no more than 16 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 4.5 - 5 km. Impact pile driving will occur for 3 to 4 hours at a time. For drilling and vibratory pile setting, the distance is much greater (21-25 km for vibratory and 7 km for drilling). Modeling estimated that drilling could occur for up to 24 hours; however, that is considered an unlikely outcome as drilling is expected to be used for short, intermittent periods to break up soils/rocks that are preventing pile advancement and is not, on its own, being used to install piles. Vibratory pile setting is estimated to occur for no more than 30 minutes. Considering a right whale that was at the edge of the minimum visibility zone (2.1 km or 3.4 km depending on foundation type) when pile driving starts, we would expect that a right whale swimming at maximum speed (9 kph) would escape from the area with noise above 160 dBre 1uPa (extending 4.5 to 25 km from the pile) in 0.5 to about 3 hours, but at the median speed observed in Hatin et al. (1.3 kph, 2013), it would take the animal up to three hours to move out of the noisy area during impact pile driving and over 5 hours for drilling. Given this swim speed, a right whale would likely be exposed to noise above the Level B threshold for the full duration of vibratory setting (up to 30 minutes).

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 74 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 opportunistic nature 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 4 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, migrating, 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 New England Wind 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 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 4.5 to 7 km out of their way depending on which pile driving noise they were avoiding (note that due to the short duration of vibratory pile setting a whale exposed to that noise would only exhibit avoidance behavior for up to an hour, which would take it 1.3 to 9 km away, depending on swim speed). 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 last no more than 4 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. This conclusion remains valid even considering an individual that was exposed to pile driving noise on a single day in multiple construction years as we would expect full recovery between exposures.

Stress responses are also anticipated in the 74 right whales experiencing temporary behavioral disruption due to exposure to noise during foundation installation. 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 up to 4 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 16 hours (if a right whale was exposed to noise from all four pin piles installed in a day, which is unlikely) and will not recur on subsequent days in a single year. Because we expect these 74 individuals to only be exposed to a single pile driving event per construction year, and we expect complete recovery between exposures, 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 74 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 typically 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 16 hours (in the unlikely event of exposure to noise from all four pin piles in a jacket foundation). 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 74 right whales exposed to pile driving noise may be in a compromised state, individual exposures will be short term (expected to be less than the 4 hours it will take to install a single pile) and none are expected to be repeated in a single year. 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 New England Wind 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 New England Wind' 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, expected to be approximately 4 hours per pile). 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 distance that an animal is expected to travel to avoid foundation installation noise (no more than 7 km from the pile being installed), the short term nature of any disturbance, and the lack of any significant differences in vessel traffic or fishing activity in that 7 km area that would put an individual whale at greater risk of vessel strike or entanglement/capture. We note that the Nantucket-Ambrose TSS, which is the area with the highest density of vessel traffic, is over 14 km away from even the closest foundation position in the WDA.

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[41] 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 patterns which include, but are not limited to, breeding, feeding, or sheltering, resting or

[41] Available at: https://www.fisheries.noaa.gov/national/laws-and-policies/protected-resources-policy-directives

migrating.

Here, we carry out that four-step assessment to determine if the effects to the 74 individuals expected to be exposed to noise above the Level B harassment threshold meet the definition of harassment. We have established that up to 74 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 (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 (approximately 4 hours for a single pile), 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 7 km). 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 (foraging, migration, resting, avoidance of threats) that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the 74 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 74 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, result in actual injury, or have any long-term effect on 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."

Blue, Fin, Sei and Sperm Whales
Behavioral responses may impact health through a variety of different mechanisms, but most Population Consequences of Disturbance (PCoD) 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 in a single year. 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 blue, sperm, sei, or fin whales are likely to be in a compromised state at the time of exposure. During exposure, affected animals may be engaged in migration, foraging, or resting. If blue, 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 (not exceeding the duration of noise exposure, up to four hours per pile); 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. If an area is avoided as a result of pile driving noise that avoidance would be limited to the duration of installation of that foundation, up to 4 hours for a monopile and up to 16 hours for a jacket foundation. 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. Blue whale cruise around 8 kph and have a burst speed around 32 ph. During impact pile driving, the area with noise above the Level B harassment threshold extends up to approximately 5 km from the pile being driven and during drilling is about 7 km from the pile (for vibratory, up to 22 km but only for 30 minutes which we do not expect to result in animals swimming that far during that 30 minute period). 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 (at least 3.3 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.

Considering the density and distribution of blue, 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 blue, 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 blue, 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 blue, 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 blue, 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 New England Wind 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, approximately 4 hours per pile). 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 sperm, fin, sei or blue 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 distance that an animal is expected to travel to avoid foundation installation noise (no more than 7 km from the pile being installed), the short term nature of any disturbance, and the lack of any significant differences in vessel traffic or fishing activity in that 7 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 4 blue, 352 fin, 49 sei, and 96 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 4 blue, 352 fin, 49 sei, and 96 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 (anticipated up to 16 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 7 km). 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 sperm, fin, sei or blue 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 up to 4 blue, 352 fin, 49 sei, and 96 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 4 blue, 352 fin, 49 sei, and 96 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 blue, 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 blue, 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."

7.1.3.3 Effects of Exposure to UXO Detonations

The proposed action as described by BOEM in the BA includes the detonation of up to 10 UXOs. NMFS OPR has also considered the detonation of up to 10 UXOs in the notice of proposed ITA. As described above, modeling was carried out to support the assessment of effects of UXO detonation. Because Park City will be required (through conditions of COP approval and conditions of the proposed ITA) to implement noise attenuation of at least 10 dB for all UXO detonations, effects from attenuated detonations are considered here.

A complete description of the modeling is included in the proposed MMPA ITA. Results are summarized here. Charge weights of 2.3 kgs, 9.1 kgs, 45.5 kgs, 227 kgs, and 454 kgs, were modeled to determine acoustic ranges to mortality, gastrointestinal injury, lung injury, PTS, and TTS thresholds. The maximum distances to the thresholds for mortality, lung injury, and gastro-intestinal injury are shown in Table 7.1.16.

Table 7.1.16 Maximum Distances to Non-Auditory Injury and Mortality Thresholds for Marine Mammals (10 dB mitigation) considering all modeled sites

Threshold Type	Marine Mammal Species	Maximum Distance (R95%m) to Thresholds	
		Adult	Calf
Mortality	Baleen whale/sperm whale	29	108
Lung Injury	Baleen whale/sperm whale	78	237
Onset Gastrointestinal Injury (all species)[a]		125	125

Source: table 27, NMFS Proposed MMPA ITA
Notes: Maximum ranges are based on worst-case scenario modeling results for charge size E12 (454 kilograms)
[a] Based on 1% of animals exposed (mortality/Lung injury).
m = meters; UXO = unexploded ordnance

OPR determined that given the impact zone sizes (less than 250 m) and the required mitigation and monitoring measures, neither mortality nor non-auditory injury are considered likely to result from the activity; as such, NMFS OPR is not proposing to authorize any non-auditory injury, serious injury, or mortality of marine mammals from UXO/MEC detonation in the MMPA ITA. Given the requirements to clear an area ranging from 2.5 to 10km from the planned detonation (depending on charge size, defaulting to 10 km if the charge size cannot be definitively identified) and the use of multiple PSO platforms and PAM, including the use of aerial platforms if the clearance zone is larger than 5 km, it is extremely unlikely that a detonation would occur with a whale within 250 m of the UXO/MEC to be detonated. As such, we agree with OPR's assessment and conclude that exposure to noise that could result in mortality or non-auditory injury is extremely unlikely to occur.

To estimate the maximum ensonified zones that could result from UXO/MEC detonations, the largest acoustic range ($R_{95\%}$; assuming 10dB attenuation) to PTS and TTS thresholds of an E12 UXO/MEC charge weight were used as radii to calculate the area of a circle (pi × r^2; where r is the range to the threshold level) for each marine mammal hearing group. The results represent the largest area potentially ensonified above threshold levels from a single detonation (Table 7.1.17).

Table 7.1.17. SEL-based $R_{95\%}$ Distances and Area for Noise above the Level A (PTS) and Level B (TTS) Thresholds for the E12 Charge Weight (454 kg) with 10 dB Attenuation

Marine Mammal Hearing Group	Threshold (dB *re 1 μPa²s*)	Distance (m) to PTS onset (R95%)	
		PTS	TTS
Low-frequency cetaceans	183	3,780	11,900
Mid-frequency cetaceans	185	461	2,550

source: Table 28 in the Proposed MMPA ITA; distances to the PTS and TTS threshold are smaller for smaller charges, see Table 28 in the Notice of Proposed MMPA ITA.

As described in the Notice of Proposed ITA, to estimate the amount of MMPA take that may occur incidental to UXO/MEC detonation, Park City calculated monthly densities for each species at the shallow portion of the OECC (representing the 12 m depth location; using a 14.1-km buffer) and the combined deepwater segment of the OECC and SWDA (20 m–45 m depths; using a 13.8-km buffer). Density data was derived from Roberts et al. 2022. For the exposure modeling, the highest density month (year-round) was used. We note that conditions of the proposed ITA will limit detonations to May – December only. For blue whales, annual density was used.

Table 7.1.18. Highest Monthly Marine Mammal Densities (Animals per 100 Km^2) Used for the Modeling of New England Wind's UXO/MEC detonations (year round) (source table 29 in Proposed ITA and Table J-6 in JASCO 2023)

Marine Mammal Species	**Density**	
	Shallow OECC maximum monthly density (individual/ 100 km^2)	Deep OECC maximum monthly density (individual/ 100 km^2)
Fin whale	0.007	0.425
North Atlantic right whale	0.116	0.707
Sei whale	0.034	0.191
Sperm whale	0.002	0.112

The estimated potential PTS and TTS exposures for a 1,000-kg charge are presented in Table 7.1.19.

Table 7.1.19. Estimated potential maximum exposures above the Level A and Level B harassment thresholds for 10 detonations with 10 dB attenuation (source: Table J-8 and J-9 in JASCO 2023)

Species	**Including 10 dB of Sound Attenuation**	
	Level A Harassment (PTS)	**Level B Harassment (TTS)**
Fin whale	1.45	13.31
North Atlantic right whale	2.48	25.31
Sei whale	0.67	6.18
Sperm whale	0	0.16

As explained in the notice of proposed ITA, as there is no more than one detonation per day, the TTS threshold is expected to represent the level above which any behavioral disturbance might occur. As such, the number of individuals estimated to be exposed to noise above the Level B harassment threshold accounts for those that would experience TTS or behavioral disturbance.

However, we note that given the short duration of a detonation (less than one second), the potential for behavioral disturbance is extremely limited. Modeling, assuming all 10 detonations are of 1,000 kg charges which is the largest anticipated in the area, predicted the exposure of less than 1 sei, less than 3 right, and less than 2 fin whales (see Table 7.1.19 above) to noise above the Level A harassment threshold and no sperm whales; the exposure estimates did not consider the clearance zones.

The size of the clearance zones are set based on charge size; if charge size is not known, the clearance zone for the largest charge (1,000 kg) will be used. Clearance zones along with the distance to the Level A and Level B harassment thresholds are presented in the table below.

Table 7.1.20 – Clearance, Level A Harassment, and Level B Harassment Zones during UXO/MEC Detonations, by Charge Weight and Assuming 10 dB of Sound Attenuation

UXO/MEC Charge Weights		Low-frequency cetaceans	Mid-frequency cetaceans
E4 (2.3 kg)	Level A harassment (m)	552	50
	Level B harassment (m)	2,820	453
	Clearance Zone (m)[a, b]	2,500*	500
E6 (9.1 kg)	Level A harassment (m)	982	75
	Level B harassment (m)	4,680	773
	Clearance Zone (m)[a, b]	4,000*	600
E8 (45.5 kg)	Level A harassment (m)	1,730	156
	Level B harassment (m)	7,490	1,240
	Clearance Zone (m)[a, b]	6,000*	1,000
E10 (227 kg)	Level A harassment (m)	2,970	337
	Level B harassment (m)	10,500	2,120
	Clearance Zone (m)[a, b]	9,000*	1,500
E12 (454 kg)	Level A harassment (m)	3,780	461
	Level B harassment (m)	11,900	2,550
	Clearance Zone (m)[a, b]	10,000*	2,000

* The clearance zone size for North Atlantic right whale is "any distance." Detonation must not occur if a North Atlantic right whale is visually or acoustically detected at any distance from the detonation site. An area extending 12 km from the detonation site will be monitored with PAM.
a - The clearance zones, which are visually and acoustically monitored, presented here for the Level B harassment thresholds were derived based on an approximate proportion of the size of the Level B harassment (TTS) isopleth.

The clearance zone sizes are contingent on Park City being able to demonstrate that they can identify charge weights in the field; if they cannot identify the charge weight sizes in the field then PCW would need to assume the E12 charge weight size for all detonations and must implement the E12 clearance zone. The entire clearance zone must be able to be monitored by the visual PSOs; aerial platforms are required for any clearance zone greater than 5,000 m.
b - Some of the zones have been rounded for PSO clarity.

Table 7.1.21. Proposed Authorization of Level A and B Harassment of Marine Mammals for Authorization Resulting from the Possible Detonation of up to 10 UXOs with 10 dB of Sound Attenuation. (source: table 29 in Proposed ITA)

Species	Including 10 dB of Sound Attenuation	
	Level A Harassment (PTS)	Level B Harassment (TTS)
Blue whale	0	1
Fin whale	2	14
North Atlantic right whale	0	27
Sei whale	2	7
Sperm whale	2	2

For sperm whales, the distance to the PTS threshold ranges from 50 to 461 m from the detonation; that is, considering even the largest charge size, a sperm whale would need to be within 461 m of the detonation to experience PTS. The distance to non-auditory injury (i.e., gastric or lung injury) is even smaller (no greater than 237 m) and the distance to the mortality threshold is even smaller still (108 m). The clearance zone for sperm whales is from 500 to 2,000 m. Given that PSOs will be monitoring the area from at least two platforms and that this will be supplemented by PAM, we expect that the clearance zone will be effective at reducing the risk of exposure of a sperm whale to noise above the Level A threshold such that PTS is extremely unlikely to occur. Similarly, we expect that the clearance zone will reduce the risk of exposure to noise that could result in mortality or lung or gastric injury such that it is extremely unlikely to occur. With these mitigation measures in place, Park City and NMFS OPR determined that there was no potential for exposure of any ESA listed whales to noise that could result in mortality, or non-auditory injury. As such, Park City did not request and NMFS OPR is not proposing to authorize any such take of sperm whales. This is consistent with the determination made in the BA by BOEM.

We note that Park City has requested, and OPR is proposing to authorize, the Level A harassment of 2 fin, 2 sei, and 2 sperm whales due to exposure to noise above the PTS threshold. As explained above, based on our independent evaluation of modeling, which represents the best available information on the distances to noise thresholds, and our consideration of the extensive minimization measures, as well as considering the limited number of detonations (10 over a two year period), and the very small number of exposures estimated as a result of modeling (see table 7.1.19 above), we conclude that exposure of right, fin, sei, or blue whales to noise above the PTS threshold during any UXO detonation for the New England Wind project is extremely unlikely to occur. We consider exposure above the Level B threshold below.

For right, fin, and sei whales (and by proxy, blue whales), the distance to the PTS threshold ranges from 552 m to 3,780 m dependent on charge size (see Table 7.1.17). The distance to non-auditory injury (i.e., gastric or lung injury) is even smaller (no greater than 237 m) and the distance to the mortality threshold is even smaller still (108 m) (Table 7.1.16). The clearance zone for right whales is "any distance" meaning that any detection of a right whale by a PSO at any distance from the PSO platform or any detection of a vocalizing right whale at any distance from the detonation site would delay detonation (noting that a distance of up to 12 km will be monitored by PAM). For blue, fin, and sei whales the clearance zone ranges from 2,500 to 10,000 m and is always more than twice the distance to the PTS threshold. Only when marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales may detonation commence. It is reasonable to expect that visual observers will be able to monitor the full extent of the 10 km exclusion zone given the multiple observer platforms, which include two vessels and an airplane. It is also important to note that given the extremely short duration of the noise associated with the detonation (one second) there is no risk of sustained or cumulative noise exposure.

Given that PSOs will be monitoring the area from at least two platforms and that this will be supplemented by PAM, and will include aerial platforms for any clearance zones greater than 5,000 m we expect that the clearance zone will be effective at reducing the risk of exposure of a right, fin, sei, or blue whale to noise above the Level A threshold such that PTS is extremely unlikely to occur. Similarly, we expect that the clearance zone will reduce the risk of exposure to noise that could result in mortality or lung or gastric injury such that it is extremely unlikely to occur. With these mitigation measures in place, Park City and NMFS OPR determined that there was no potential for exposure of any ESA listed whales to noise that could result in mortality, or non-auditory injury. As such, Park City did not request and NMFS OPR is not proposing to authorize any such take of right, fin, sei, or blue whales. This is consistent with the determination made in the BA by BOEM. We note that Park City has requested, and OPR is proposing to authorize, the Level A harassment of 2 fin whales, 2 sei whales, and 2 sperm whales (no blue or right whales) due to exposure to noise above the PTS threshold. As explained above, based on our independent evaluation of modeling, which represents the best available information on the distances to noise thresholds, and our consideration of the extensive minimization measures, as well as considering the limited number of detonations (10 over a two year period), and that no exposures were estimated as a result of modeling, we conclude that exposure of any blue, fin, sei, or right whales to noise above the PTS threshold during any UXO detonation for the New England Wind project is extremely unlikely to occur. We consider exposure above the Level B threshold below.

As explained in the proposed MMPA ITA, to determine the amount of Level B harassment take proposed for authorization, OPR considered the density based exposure estimates for right, sei, fin, and sperm whales (rounding each year's exposure up to whole numbers and adding the two years to get a total). No exposure of blue whales to UXO detonations was predicted due to their low density in the area and the limited duration of UXO detonations (i.e., less than a second, once per day, for no more than 10 days spread out over two years).

As explained in the Notice of Proposed ITA, exposure to noise above the Level B harassment (but below the PTS threshold) for detonations is expected to result in TTS, with behavioral response limited to brief startle reactions (due to the short duration of the detonation). Effects to individuals from this extremely short behavioral disturbance will be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore insignificant. Whales exposed to noise above the Level B harassment threshold may experience minor TTS (limited due to the very limited exposure period). As explained in the consideration of exposure to pile driving noise, TTS affects an individual through temporary hearing impairment which can affect the behavior of the individual by making it more difficult to hear certain sounds; however, while this minor TTS may affect the way an individual senses its environment we do not expect this minor TTS to affect communication between individuals or affect the ability of an individual to migrate, forage or rest. As explained in the pile driving section above, behavioral responses caused by TTS may meet the ESA definition of harassment but does not on its own meet the definition of harm. That is because, while TTS is expected to create the likelihood of injury by significantly disturbing normal behavioral patterns (i.e. ESA harassment) it is not likely to result in significant impairment of essential behavioral patterns that actually kill or injure any individuals (i.e. ESA harm).

As explained above, we have determined that due to the clearance procedures, the animals that modeling predicted would be exposed to noise above the PTS threshold are extremely unlikely to actually experience PTS. However, given the large area during which noise above the TTS threshold would be experienced, and that it exceeds the size of the clearance zone (with the exception of right whales, which trigger delay if detected at any distance) we cannot discount the potential for exposure above the Level B threshold. We also note that due to the size of the area with noise above the Level B harassment threshold (extending up to almost 12 km from the detonation for the largest charge sizes) it is unlikely that the visual PSOs will be able to detect all whales, including right whales, at the outer edges of the clearance zone, particularly if they are not vocalizing or are diving. As such, we anticipate that, as estimated by modeling, and as proposed for authorization by OPR, up to 27 right whales, 16 fin whales, 9 sei whales, and 4 sperm whales may be exposed to noise during UXO detonations that may result in incidental take. As explained above, we have determined, that the avoidance, minimization, and monitoring measures that are part of the proposed action (inclusive of those proposed as conditions of the MMPA ITA) will be effective at reducing risk of exposure of right, fin, sei, and sperm whales to noise that could result in PTS such that it is extremely unlikely to occur. However, given the large distance to the TTS threshold we do not expect that the pre-clearance will eliminate all exposure of whales to the planned detonations. Therefore, we expect that up to 27 right whales, 16 fin whales, 9 sei whales, and 4 sperm whales will experience TTS as a result of exposure to UXO detonation noise. Consistent with the definitions and analysis presented above, we consider these effects to meet the definition of ESA take by harassment but not harm. The effects to individuals experiencing TTS are the same as those effects described above in the consideration of effects of pile driving noise. We expect recovery from the noise exposure to occur within hours to days of exposure and that there would be no permanent effects to any individuals.

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 New England Wind 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) is the best available data for estimating operational noise of the New England Wind 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. 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.

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 non-auditory 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 and the nearby Buzzards Bay Buoy, wind speeds are typically less than 30 km/h; 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 6% of the time across a year.

Given the conditions necessary to result in noise above 120 dB re 1uPa 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 any larger than 50m from the WTG foundation. As such, 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) represents WTGs that are of a smaller capacity than those proposed for use at New England Wind. 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 New England Wind WDA, operational noise is not expected to be detectable above ambient noise at a distance more than 50 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, Park City 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 30 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. Horizontal impact distances to the Level A threshold is less than 1 m from the source (Table I-1, COP Appendix III-M).

Table 7.1.22 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	Horizontal distance (m) to Level B Harassment Threshold (m)
SBP: Boomer	Applied Acoustics AA251 Boomer	178
SBP: Sparker	GeoMarine Geo Spark 2000 (400 tip)	141

source: table 30 in MMPA ITA

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 7.1.23 presents the amount of take (MMPA Level A and Level B harassment) proposed for authorization by NMFS OPR for the 5-years of HRG surveys considered in the proposed LOA. See also Table 31 in the Notice of Proposed ITA.

Table 7.1.23. Amount of MMPA Take by Level B Harassment Proposed for Authorization for 5-years of HRG Surveys

Marine Mammal Species	Over 5 Year Period	
	Level A	Level B
Fin Whale	0	20
North Atlantic Right Whale	0	25
Sei Whale	0	10
Sperm Whale	0	5

source: table 31 in Proposed MMPA ITA

NMFS OPR is proposing to authorize the take, by Level B harassment, of 25 right whales, 20 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: insignificant). 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 1m. 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 (less than 1 m) and because the sound source is being towed behind a vessel and therefore is moving. Considering the sources that would be used for the surveys, the distance to the Level B harassment threshold extends approximately 141 m and 178 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 178 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 (178 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. Thus, while we anticipate effects to be discountable as explained above, even in the extremely unlikely event that such effects were to occur, we anticipate the effects of these temporary behavioral changes to be so minor as to be insignificant. Insignificant and discountable 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 7.1.24). The cumulative metric accumulates all sound exposure within a 24-hour period and is therefore different from a peak, or single exposure, metric.

Table 7.1.24. 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 $Pa^2 \cdot s$ SEL_{cum} 232 dB re: 1 μPa SPL (0-pk)	189 dB re: 1 $\mu Pa^2 \cdot s$ SEL_{cum} 226 dB re: 1 μPa SPL (0-pk)

Non-auditory Injury Criteria for Explosives (Detonation of Unexploded Ordnance)
NMFS has independently reviewed and adopted criteria used by the U.S. Navy to assess the potential for non-auditory injury (i.e., lung and GI tract) and mortality from underwater explosive sources as presented in U.S. Navy (2017) and considers it the best available science. Unlike auditory thresholds, these depend upon an animal's mass and depth. Table 7.1.25 provides mass estimates used in the assessment. For sea turtles, harbor seal (*Phoca vitulina*) pup and adult masses are used as conservative surrogate values as outlined in U.S. Navy (2017).

Single blast events within a 24-hour period are not presently considered by NMFS to produce behavioral effects if they are below the onset of TTS thresholds for frequency-weighted SEL (LE,24h) and peak pressure levels. As only one charge detonation per day is planned for the Project, the effective disturbance threshold for single events in each 24-hour period is the TTS onset.

Table 7.1.25 Representative Pup and Adult Mass Estimates Used for Assessing Impulse-based Onset of Lung Injury and Mortality Threshold Exceedance Distances

Impulse Animal Group	Representative Species	Pup Mass (kg)	Adult Mass (kg)
Sea Turtles	Harbor Seal (*Phoca vitulina*)	8	60

Note: These values are based on the smallest expected animals for the species that might be present within Project areas. Masses listed here are used for assessing impulse-based onset of lung injury and mortality threshold exceedance distances.
kg = kilograms

Hearing Group	Mortality (Severe lung injury)*	Slight Lung Injury*	G.I. Tract Injury
Sea Turtles	*Cell 1* Modified Goertner model; Equation 1	*Cell 2* Modified Goertner model; Equation 2	*Cell 3* *L*pk,flat*:* 237 dB

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

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

Equation 1: $103M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s

Equation 2: $47.5M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s

M animal (adult and/or juvenile) mass (kg) (Table C.9 in DoN 2017)
D animal depth (meters)

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 is also considered in the lessee's acoustic modeling (JASCO 2023, COP Appendix III-M). 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 New England Wind project in the context of the noise thresholds presented above.

Drilling to Support WTG and ESP Foundation Installation
As described in JASCO 2023, drilling noise was modeled at each of three site locations incorporating the required 10 dB sound attenuation. Based on the modeling, drilling noise is not expected to exceed the thresholds identified for injury or behavioral disturbance of sea turtles. As such, effects to sea turtles as a result of exposure to drilling noise to support foundation pile installation is extremely unlikely to occur and effects are discountable. No take is anticipated to occur as a result of exposure of any sea turtles to noise during drilling to support foundation installation.

Impact and Vibratory Pile Driving for WTG and ESP 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 pile types considering impact pile driving and vibratory pile setting (JASCO 2023). Similar to the results presented for marine mammals, the exposure ranges (ER95%) for sea turtles were modeled assuming 10 dB broadband attenuation and a summer acoustic propagation environment (JASCO 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 ($ER_{95\%}$).

For impact pile driving, exposure range estimates for the modeled piles and pile locations for sea turtles are included in Section 3.9.1.2, Tables 59 – 67 in JASCO 2023. Based on these results, noise is not expected to exceed the peak injury criteria (232 dB) during any pile driving for the New England Wind project. Modeling to calculate distances to the TTS threshold was not carried out. The modeling results to the onset of injury (cSEL) and behavioral thresholds are presented in tables 7.1.26 below. Modeling was also carried out for monopile installation with the 5,000 kJ impact hammer; distances to thresholds are slightly smaller than with the 6,000 kJ hammer.

Table 7.1.26 Exposure ranges ($ER_{95\%}$) in km to sea turtle injury threshold criteria (204 dB cSEL) and behavioral thresholds: 10 dB attenuation – Impact Driving Only

Species	12 m monopile One/day 6,000 kJ		12 m monopile Two/day 6,000 kJ		13 m monopile One/day 6,000 kJ		13 m monopile Two/day 6,000 kJ		4 m jacket (4/day) 3,500 kJ	
	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior
Kemp's ridley	0	1.19	0	0.94	0	0.87	0	0.99	0.42	1.12
Leatherback	0.30	1.46	0.26	1.47	0.25	1.37	0.29	1.50	1.28	1.28
loggerhead	0	1.39	0	1.41	0	1.48	0	1.32	0.48	1.29
green	0	1.29	0	1.25	0.19	1.31	0.01	1.47	0.24	1.20

Modeling was also carried out for vibratory pile driving alone and vibratory setting followed by impact piling (see Section 3.9.2.2, Tables 77-85 in JASCO 2023). Based on these results, noise is not expected to exceed the peak injury criteria (232 dB) during any pile driving for the New England Wind project. Modeling to calculate distances to the TTS threshold was not carried out. The modeling results to the onset of injury (cSEL) and behavioral thresholds are presented in tables 7.1.27 below. Modeling was also carried out for monopile installation with the 5,000 kJ impact hammer; distances to thresholds are slightly smaller than with the 6,000 kJ hammer. Modeling indicates that vibratory installation alone will not exceed the onset of injury (peak or cumulative) thresholds.

Table 7.1.27 Exposure ranges ($ER_{95\%}$) in km to sea turtle injury threshold criteria (204 dB cSEL) and behavioral thresholds: 10 dB attenuation – Vibratory and Impact

Species	12 m monopile One/day 6,000 kJ		12 m monopile Two/day 6,000 kJ		13 m monopile One/day 6,000 kJ		13 m monopile Two/day 6,000 kJ		4 m jacket (4/day) 3,500 kJ	
	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior	Injury cSEL	Behavior
Kemp's ridley	0	1.37	0	0.93	0	1.16	0.27	1.20	0.28	1.09
Leatherback	0.30	1.47	0.39	1.52	0.28	1.54	0.41	1.51	1.48	1.28
loggerhead	0	1.43	0.21	1.17	0	1.39	0.31	1.43	0.58	1.30
green	0	1.29	0	1.23	0	1.22	0.01	1.45	0.38	1.24

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 (JASCO 2023). JASCO (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 JASCO (2023) and in BOEM's BA, there are limited density estimates for sea turtles in the WDA. JASCO used sea turtle densities obtained from the US Navy Operating Area Density Estimate (NODE) database on the Strategic Environmental Research and Development Program Spatial Decision Support System (SERDP-SDSS) portal (DoN, 2012, 2017) and from the Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles (Kraus et al. 2016). These data are summarized seasonally (winter, spring, summer, and fall). Since the results from Kraus et al. (2016) use data that were collected more recently, JASCO used those preferentially where possible. Sea turtles were most commonly observed in summer and fall, absent in winter, and nearly absent in spring during the Kraus et al. (2016) surveys of the MA WEA and RI/MA WEAs. Because of this, the winter and spring densities from SERDP-SDSS are used for all species. It should be noted that SERDP-SDSS densities are provided as a range, where the maximum density will always exceed zero, even though turtles are unlikely to be present in winter. As a result, winter and spring sea turtle densities in the lease area, while low, are likely still overestimated. For summer and fall, the more recent leatherback and loggerhead densities extracted from Kraus et al. (2016) were used. These species were the most commonly observed sea turtle species during aerial surveys by Kraus et al. (2016) in the MA/RI and MA WEAs. However, Kraus et al. (2016) reported seasonal densities for leatherback sea turtles only, so the loggerhead densities were calculated for summer and fall by scaling the averaged leatherback densities from Kraus et al. (2016) by the ratio of the seasonal sighting rates of the two species during the surveys. The Kraus et al. (2016) estimates of loggerhead sea turtle density for summer and fall are slightly higher than the SERDP-SDSS densities, and while reasonable, are more conservative. Kraus et al. (2016) reported only six total Kemp's ridley sea turtle sightings, so the estimates from SERDPSDSS were used for all seasons. Green sea turtles are rare in this area and there are no density data available for this species, so the Kemp's ridley sea turtle density is used as a surrogate as we know green sea turtles do occur in the area. JASCO provided density estimates for an area with a 6.2-km perimeter around the WDA (used for exposure estimates for impact only pile driving) and a 10-km perimeter around the WDA (used for exposure estimates for vibratory and impact pile driving). It is important to note that the differences between these two density estimates are extremely small and when used to estimate the number of turtles in a 100 km^2 area, with fractions rounded up to whole animals, there are no differences.

Table 7.1.28 Sea turtle density estimates for a 6.2 km perimeter around the New England Wind WDA

Species	Density (animals/100km^2) [a]			
	Spring	*Summer*	*Fall*	*Winter*
Green sea turtle [b]	0.019	0.019	0.019	0.019
Kemp's ridley sea turtle	0.019	0.019	0.019	0.019
Leatherback sea turtle	0.022	0.630[c]	0.873[c]	0.022
Loggerhead sea turtle	0.103	0.206[d]	0.633[d]	0.103

(source: JASCO 2023 (table 21)

a Density estimates are extracted from SERDP-SDSS NODE database within a 6.2 km perimeter of New England Wind, unless otherwise noted.
b Kraus et al. (2016) did not observe any green sea turtles in the RI/MA WEA. Densities of Kemp's ridley sea turtles are used as a conservative estimate.
c Densities calculated as averaged seasonal densities from 2011 to 2015 (Kraus et al. 2016).
d Densities calculated as the averaged seasonal leatherback sea turtle densities scaled by the relative, seasonal sighting rates of loggerhead and leatherback sea turtles (Kraus et al. 2016).

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); thus, while the density estimates suggest the presence of sea turtles year round, sea turtles are extremely unlikely to occur from January to April due to cold water temperatures.

We considered whether sufficient information was available on detection rates from aerial surveys from which we could further adjust the density or exposure estimates. 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.

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 JASCO 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 for Construction Schedule A (89 monopiles and 2 jackets in year 1, 18 monopiles and 24 jackets in year 2) and B (55 monopiles and 3 jackets in year 1, 53 jackets in year 2 and 22 jackets in year 3). Considering all scenarios, no sea turtles are expected to be exposed to noise above the peak auditory injury (PTS) threshold; this is because noise during pile driving is not expected to exceed the peak injury (PTS) threshold in any scenario proposed for the project. The tables below contain the modeled number of sea turtles predicted to be exposed to noise above the injury and behavioral thresholds for Construction Schedule A and B. 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. These estimates consider the area ensonified above the identified threshold, the number of days of foundation installation, and the density estimates outlined above.

Table 7.1.29. Modeled Number of Sea Turtles Predicted to Receive Sound Levels Above Cumulative and Peak Injury and Behavioral Criteria Considering Construction Schedule A and B (source: JASCO 2023).

Sea Turtle Species	Construction Schedule A			Construction Schedule B		
	Injury (Peak)	Injury (Cumulative /24 hour)	Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)	Injury (Peak)	Injury (Cumulative/ 24 hour)	Individuals Exposed to Noise above the 175 dB threshold (TTS and/or Behavioral Effects)
Kemp's ridley	0	<0.01	0.12	0	0.02	0.27
Leatherback	0	2.05	5.20	0	4.17	5.40
Loggerhead	0	0.58	7.02	0	1.11	9.85
Green	0	0.04	0.35	0	0.11	0.66

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 7.1.30. Maximum predicted exposure for each species across pile driving scenarios

Sea Turtle Species	Construction Schedule A		Construction Schedule B	
	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)
Green	0	1	1	1
Kemp's ridley	0	1	0	1
Leatherback	2	6	5	6
Loggerhead	1	7	2	10

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 New England Wind 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
New England Wind 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, New England Wind 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 7.1.24), 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 Zone
BOEM will require Park City 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. 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 a 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 clearance zone after pile driving has begun, the PSO will request a temporary cessation of pile driving as explained for marine mammals above.

As required by the proposed 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 one dedicated PSO vessels stationed or transiting to allow effective monitoring of the entirety of the minimum visibility (2,100 m or 3,400 m depending on pile type), 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 between 0 and 1.48 km depending on species and pile type. For loggerhead and Kemp's ridleys, the modeled CPA is outside the 250 m clearance zone for installation of jacket piles (impact only and vibratory/impact) and for vibratory/impact of 13 m monopiles (2/day). For leatherbacks, the modeled CPA is outside the 250 m clearance zone in all pile driving scenarios. For green sea turtles, the modeled CPA is outside the 250 m clearance zone only for installation of jacket foundations with vibratory setting followed by impact driving. This means that across all pile driving scenarios considered for the project, pile driving could start with a sea turtle close enough that modeling predicts it would be exposed to noise over the pile driving event that could result in PTS. Similarly, this means that shutdown would not be called for in time for prevention of exposure to noise that is modeled to result in PTS. As such, the clearance and shutdown procedures are not expected to eliminate exposure of sea turtles to pile driving noise that could result in PTS. In all cases, the CPA for behavioral disturbance is well outside the 250 m clearance and shutdown distance. Therefore, we are not adjusting the modeled exposures of sea turtles above the PTS or behavioral thresholds to account for the clearance or shutdown procedures.

Soft Start

As described above, before full energy pile driving begins, the hammer will operate at 10-20% energy for 20 minutes (600-1200 kJ for WTG monopiles, 350-700 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 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 that is greater than the 250 m clearance and shutdown zone for some species and piles (Table 7.1.26 and 7.1.27; ER95% in km to sea turtle injury threshold criteria (204 dB cSEL) is greater than 0.25 km for some 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 1.48 km from the pile, which in some cases is larger than the 250 m clearance and shutdown zone. The exposure analysis conducted by JASCO (2023), as rounded to whole animals as explained above, predicts exposure of no Kemp's ridley, and up to 5 leatherbacks, 2 loggerheads, and 1 green sea turtle to noise above the cumulative PTS threshold (dependent on construction schedule). As the modeling does not incorporate aversion behavior it is likely that the actual number of animals exposed to noise above the PTS threshold may be less; however, we have no way to reduce this estimate based on aversion behavior.

PTS is expected to consist of minor degradation of hearing capabilities occurring predominantly at the 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 lose a few decibels in its hearing sensitivity, severe hearing impairment is not an expected outcome. Sea turtle do not vocalize and therefore do not rely on hearing for communication. Sea turtles may use acoustic cues such as waves crashing, wind, vessel and/or predator noise to perceive the environment around them. Impacts on hearing sensitivity would be most likely to affect the ability to detect environmental cues; however, sea turtles are not known to rely heavily on sound for life 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, the likelihood that the loss of hearing in a sea turtle would impact its fitness (i.e., survival or reproduction) is low. 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.

With this minor degree of PTS, we do not expect it to affect any of the affected individuals' overall health, reproductive capacity, or survival. The up to 5 leatherbacks, 2 loggerheads, and 1 green sea turtle that experience PTS could be less efficient at detecting environmental cues which could theoretically impact their ability to avoid predators or other threats, but that risk is considered low. 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 and nesting, or survival of any of the up to sea turtles that experience PTS.

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 1 Kemp's ridleys, 6 leatherbacks, 10 loggerheads, and 1 green sea turtle will be exposed to noise above the behavioral impacts threshold (Tables 7.1.30; with lower numbers if schedule A is implemented). Neither New England Wind 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 reasonably 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 long-term 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 4 hours it takes to drive a single pile; we do not expect exposure of the entire duration of pile driving for all pin piles in a jacket foundation). 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 600 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 1.5 km) and displacement from a particular areas would last, at the longest, the duration of pile driving (3 to 4 hours at a time for a monopile, up to 16 hours for a jacket foundation). 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 1.5 km or the time to drive a pile, approximately 4 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 foundation installation noise (approximately 4 hours per pile 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 New England Wind 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 (approximately 4 hours per pile) 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 approximately 22-91 days per year for two to three years, with pile driving occurring for no more than approximately 16 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 1 Kemp's ridley, 6 leatherback, 10 loggerhead, and 1 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 1 Kemp's ridley, 6 leatherback, 10 loggerhead, and 1 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 (approximately 4 hours per 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 1.6 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 1 Kemp's ridley, 6 leatherback, 10 loggerhead, and 1 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 1 Kemp's ridley, 6 leatherback, 10 loggerhead, and 1 green sea turtles 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 creating the likelihood of injury, it will not actually kill or injure any sea turtles directly or 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 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."

UXO/MEC Detonation

As explained above, no more than 10 detonations of UXO are anticipated in the WDA. No more than one detonation will occur in any 24-hour period and the 10 detonations would be spread out over 2 calendar years. Mitigation for UXO detonations that is described in the BA as being part of the proposed action include pre-clearance zones, restricting detonations to daylight hours, and the use of a dual noise mitigation system for all detonations to achieve a minimum of 10 dB sound attenuation. Additionally, enough vessels would be deployed to provide 100% temporal and spatial coverage of the pre-clearance zones and, if necessary, aerial surveys would be used to provide coverage. The size of the pre-clearance zone for sea turtles, as clarified by BOEM during the consultation period, is 500 m regardless of charge size. Conditions of the proposed MMPA ITA limit detonations to May 1 – December 31 of any year.

Modeling of acoustic fields for UXO detonations within the MA/RI WEA has been carried out (Hannay and Zykov 2022). This reference is described in the BA; however, it appears that there were errors made in transcribing the distances to thresholds of concern. Consistent with NMFS recommendations, Hannay and Zykov calculated ranges to distances where a sea turtle would be expected to experience mortality and non-auditory injury (gastrointestinal and lung injury) based on the representative body mass of harbor seal pups and adults as surrogates for sea turtles (see explanation of thresholds above). We have determined that given the size of leatherback sea turtles in the area, the harbor seal adult mass is the best representative while for the other species, the pup mass is appropriate. Table 7.1.39 presents the R95%-modeled distances (and area) to the mortality and non-auditory injury thresholds from a detonation of a 454 kg charge (the largest anticipated to occur) in 45 m of water (the depth with the largest distances to thresholds) and incorporation of the required 10dB attenuation, consistent with the results reported in tables 30 – 38 in Hannay and Zykov 2022. Table 7.1.31 presents the R95%-modeled distances (and area) to the sea turtle PTS and TTS thresholds for the maximum anticipated detonation (454 kg charge) with 10 dB attenuation, consistent with the results reported in tables 29 and 40-47.

Table 7.1.31 Maximum Ranges (meters) to Non-Auditory Injury Thresholds for Sea Turtles – Mitigated (10 dB Attenuation), with Harbor Seal Pup and Adult Proxy, threshold exceedances for effects observed in 1% of animals

Injury Type	R95% distance - Adult (km)	R95% Area - Adult (km2)	R95% distance - Pup (km)	R95% distance - Area (km^2)
Mortality - Impulse (severe lung injury)	0.224	0.16	0.332	0.35
Injury - Impulse (slight lung injury)	0.429	0.58	0.606	1.15
Gastrointestinal Injury	0.125	0.049	0.125	0.049

Notes: Maximum ranges are based on modeling results: charge size E12 (454 kilograms), deepest water depth (45 meters).

Table 7.1.32 Maximum Ranges to PTS and TTS-onset thresholds in the Lease area for the largest charge sizes with 10 dB mitigation

Threshold	$R_{95\%}$ distance (km)	R95% Area (km^2)
PTS peak	0.210	0.14
PTS SEL	0.472	0.7
TTS peak	0.398	0.5
TTS SEL	2.25	15.9

Note that in the BA, estimates of sea turtles exposed to noise above the thresholds of concern was not carried out. During the consultation period, we developed estimates as described here. The number of potential sea turtle exposures to noise above the thresholds of concern were calculated by multiplying the expected densities of sea turtles in the WDA (considering the Lease Area where UXO may be detonated) (table 7.1.33) by the area of water likely to be ensonified above the defined threshold levels (tables 7.1.31 and 7.1.32). The result was then multiplied by 10 (number of detonations considered).

Table 7.1.33 Expected Densities of Sea Turtles in the WDA

Species	Maximum Seasonal Density (individuals/km^2)
Kemp's ridley	0.0002
Leatherback	0.0087
Loggerhead	0.0063
Green	0.0002

source: BOEM BA Table 3-29

Table 7.1.34 Total Number of ESA-Listed Sea Turtles Estimated to be Exposed to Sound Levels above PTS and TTS thresholds for the Detonation of 3 UXOs – Mitigated (10 dB)

Species	PTS	Mortality (severe lung injury)	Injury (slight lung injury)	Gastrointestinal Injury	TTS
Kemp's ridley	<0.01	<0.01	<0.01	<0.01	0.03
Leatherback	<0.01	0.03	0.06*	<0.01	1.38
Loggerhead	<0.01	0.02	0.07	<0.01	1.00
Green turtle	<0.01	<0.01	<0.01	<0.01	0.03

Source: Distances to thresholds taken from Hannay and Zykov (2022) as described in Tables 7.1.39 and Tables 7.1.40 above
**using harbor seal adult equivalent rather than pup given the size of leatherbacks in the area*

Considering all 10 UXO detonations, the modeling combined with the exposure estimates predicts that less than 0.07 Kemp's ridley, leatherback, loggerhead, or green sea turtles would be exposed to noise that could result in mortality or any form of injury, including PTS. This exposure modeling did not incorporate consideration of any mitigation measures other than the 10 dB noise attenuation requirement. The clearance zone for sea turtles will extend 500 m from the site of the planned detonation. Given the small distances to the mortality and injury thresholds and the proposed measures to ensure the area within 500 m of the detonation is clear of sea turtles prior to detonation, this risk is even lower than the already very low exposure estimates, which are approaching zero even considering all 10 detonations. In consideration of the distances to thresholds, the very small (approaching zero) modeled exposure estimates, the 500 m clearance zone, and that that detonations will be limited to daylight only and that the area will be monitored by multiple vessels and use aerial coverage as necessary to ensure complete visibility of the pre-clearance area, we have determined that it is extremely unlikely that any sea turtles will be close enough to any of the 10 detonations to experience mortality or any injury, inclusive of PTS.

As reflected in Table 7.1.34, using the modeled distances to the TTS thresholds and the density estimates, we predict 0.03 green and 0.03 Kemp's ridleys to be exposed to noise that could result in TTS and predict the exposure of 1 loggerhead and 1.38 leatherback to noise above the TTS threshold. The distance to the TTS threshold (2.25 km) exceeds the sea turtle clearance zone and is larger than the distance we would reasonably expect observers would be able to detect sea turtles. As such, based on this analysis, we expect that no more than 1 loggerhead and 2 leatherbacks could experience TTS as a result of exposure to noise from UXO detonations. Effects of TTS would be the same as those addressed for pile driving above; as such, we consider TTS as harassment in the context of the ESA definition of take. We note that this analysis is based on all 10 UXOs being 454-kg charges; as it is entirely unknown what size the UXOs that may need to be detonated (as a result of not being able to be avoided or relocated) will be, we consider it reasonable to base on our analysis on consideration that all 10 UXOs are this large. In the event that the UXOs detonated are smaller, the distances to thresholds would be smaller (see Hannay and Zykov 2022); however, we note that considering TTS, detonation of three of the five charge sizes modeled would result in distances above the TTS threshold exceeding the 500 m clearance zone.

Modeling was not carried out to estimate the number of sea turtles exposed to noise above the 175 dB behavioral threshold. However, given that the duration of the noise exposure will last only as long as the explosion (one second), we expect that any behavioral response would also be limited to that extremely short duration and as such, be a startle response. Any effects to sea turtles exposed to noise above the behavioral threshold but below the TTS threshold would be so small that they cannot be meaningfully measured, evaluated, or detected. As such, effects on behavior are insignificant.

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.

ESA-listed turtles could be exposed to a range of vessel noises within their hearing abilities. Depending on the context of exposure, potential responses of green, Kemp's ridley, leatherback, and loggerhead sea turtles to vessel noise disturbance, would include startle responses, avoidance, or other behavioral reactions, and physiological stress responses. Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggested that sea turtles may habituate to vessel sound and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007).

Therefore, the noise from vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

For these reasons, vessel noise is expected to cause minimal disturbance to sea turtles. If a sea turtle detects a vessel and avoids it or has a stress response from the noise disturbance, these responses are expected to be temporary and only endure while the vessel transits through the area where the sea turtle encountered it. Therefore, sea turtle responses to vessel noise disturbance are considered insignificant (i.e., so minor that the effect cannot be meaningfully evaluated), and a sea turtle would be expected to return to normal behaviors and stress levels shortly after the vessel passes by.

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 New England Wind 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 is the best available data for estimating operational noise of the New England Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m from the turbine when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA and the nearby Buzzards Bay Buoy, wind speeds are typically less than 30 km/h; 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 6% 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. As underwater noise associated with the operation of the WTGs is below the thresholds for considering behavioral disturbance, 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 New England Wind this is limited to boomers 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. For the equipment proposed for use, 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 7.1.35 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*	*RMS*
SBP: Boomers	176 dB SEL 207 dB RMS 216 PEAK	0	0	40
SBP: Sparkers	188 dB SEL 214 dB RMS 225 PEAK	0	0	90
Multi-beam echosounder (100 kHz)	185 dB SEL 224 dB RMS 228 PEAK	NA	NA	NA
Multi-beam echosounder (>200 kHz) (mobile, non-impulsive, intermittent)	182 dB SEL 218 dB RMS 223 PEAK	NA	NA	NA
	184 dB SEL 220 dB RMS	NA	NA	NA

Side-scan sonar (>200 kHz) (mobile, non-impulsive, intermittent)	226 PEAK			

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 and 40 m for boomers (Table 7.1.35). 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, 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.

NMFS has adopted thresholds described in FHWG 2008 and Popper et al. 2014 for the anticipated onset of mortality and physical injury resulting from exposure to underwater explosives. These thresholds are:

- onset of mortality (received level): $L_{p,\text{0-pk,flat}}$: 229 dB
- onset of physical injury (received level): $L_{p,\text{0-pk,flat}}$: 206 dB; $L_{\text{E},p,,\text{12h}}$: 187 dB (fish 2 grams or greater); $L_{\text{E},p,,\text{12h}}$: 183 dB (fish less than 2 g).

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

Foundation Installation
As outlined above, with the exception of any suction bucket foundations installed during Phase 2, all other WTG and ESP foundations will involve pile driving. Piles may be driven by impact driving alone or with vibratory setting followed by impact driving and either of those may also involve drilling. As explained above, Park City has estimated the portion of total foundations that will require vibratory setting and the portion that will require drilling.

An assessment of acoustic effects of the proposed drilling concluded that injury to fish, including Atlantic sturgeon are unlikely to occur due to the source levels and other noise characteristics (JASCO 2023). We have reviewed this determination and agree that exposure of Atlantic sturgeon to noise that could result in physiological effects is extremely unlikely to occur and thus, discountable. Modeling was carried out to estimate the distance to the 150 dB re 1uPa RMS behavioral threshold during drilling (JASCO 2023, Appendix K); noise is predicted to exceed this threshold at a distance of up to 70 m from the pile (tables 17-19 in JASCO 2023 Appendix K). Given these small distances, and that this is likely to be within the bubble curtain, exposure of any Atlantic sturgeon to noise during drilling that may result in a behavioral response is extremely unlikely to occur. No take of Atlantic sturgeon from any DPS is anticipated to result from drilling to facilitate foundation installation.

Distances to potential injury and behavioral disruption thresholds for fish exposed to pile driving sound for the different piles (jacket (4, 4-m pin piles) and 12-m and 13-m diameter monopiles) were modeled (JASCO 2023, COP Appendix III-M) considering impact pile driving and vibratory setting. 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 (JASCO 2023) considering 10dB 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 29-40 in JASCO 2023 (COP Appendix III-M). The distances to the identified criteria for the different pile types are summarized in the tables below.

Table 7.1.36 Acoustic range (R95%) in m to sturgeon threshold criteria with 10 dB attenuation – impact pile driving and vibratory setting. The largest modeled distances and maximum hammer energy (6,000 kJ for monopiles and 3,500 kJ for jackets) are shown.

	Impact Only			Vibratory Setting		
	12 m monopile	13 m monopile	4 m jacket (4 pin piles)	12 m monopile	13 m monopile	4 m jacket (4 pin piles)
peak injury (206)	108	126	128	N/A	N/A	N/A
cumulative injury (187)	4,704	5,362	8,200	N/A	N/A	N/A
behavior (150 dB re 1uPa)	10,789	11,431	8,656	3,963	4,991	5,358

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 Park City 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 section 3 and Appendix A and B.

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 New England Wind 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, New England Wind 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., up to 1,200 kJ for monopiles and 700 kJ for jackets), for a minimum of 20 minutes. During installation of any piles, at this hammer intensity, a sturgeon would need to be very close to the pile being driven; the single strike SEL for the 13 m monopile at 750 m from the pile, at 2000 kJ energy (which exceeds the energy during the soft start) is approximately 177 dB re 1uPa, which is significantly lower than the 206 dB re 1uPa threshold (see Tables F-2 in JASCO 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 and are therefore, expected to be at least several hundred meters from the pile before full energy pile driving begins. 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, Park City 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 Pile Driving for Foundation Installation
Given the characteristics of sound produced during vibratory pile installation and the lack of observations of physical injury on fish from vibratory underwater sound pressure levels, NMFS does not consider there to be a risk of injury to Atlantic sturgeon due to exposure to vibratory pile driving noise. As such, it is extremely unlikely that any Atlantic sturgeon would experience injury due to exposure to noise generated during vibratory pile setting.

Acoustic range modeling (Table 7.1.36) indicates that in order to be exposed to pile driving noise that could result in injury, an Atlantic sturgeon would need to be within 108-126 m of a monopile and within 128 m of a pin pile for a single pile strike (based on the 206 dB peak threshold) of the impact hammer. 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 750 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 pile installation with an impact hammer.

Considering the 187 dB SELcum threshold (see Table 7.1.36), an Atlantic sturgeon would need to remain within approximately 4.7-5.3 km of a single monopile (with distance dependent on location and pile size) for the duration of the operation of the impact hammer (i.e., 3 to 4 hours) or stay within approximately 8.2 km of all pin piles installed in a 24 hour period (3-4 hours per pile, 12 -16 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 3 to 4 hours it would take to install a single pile is at least 16.2 km; this is at least double the distance a sturgeon would need to swim to escape from noise above the cumulative injury (187 dB cSEL) threshold considering the 12 m (4.7 km), 13 m (5.3 km) and pin piles (8.2.km considering all 4 piles in a single foundation). 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 where noise is above 150 dB re 1uPa RMS. 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 3 to 4 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 8.6 to 11.4 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 3.9-5.3 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 22 to 52 days per year over a 2 to 3 year period (total of 87 to 113 days dependent on Schedule A or B), 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 11.4 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 or ESP foundations.

UXO/MEC Detonation

Injury to fish from exposures to blast pressure waves is attributed to compressive damage to tissue surrounding the swim bladder and gastrointestinal tract, which may contain small gas bubbles. For UXO detonations, modeling was conducted as described above for sea turtles to estimate the distances to thresholds used to evaluate onset of injury (Table 7.1.37, see table 39 in Hannay and Zykov 2022).

Table 7.1.37 Maximum range to thresholds used to evaluate onset of injury for Atlantic sturgeon exposed to underwater explosives with 10 dB attenuation. (source: Table 39 in Hannay and Zykov 2022)

Onset of Injury	**Maximum (m)**				
	E4 (2.3 kg)	**E6 (9.1 kg)**	**E8 (45.5 kg)**	**E10 (227 kg)**	**E12 (454 kg)**
Lp, 0-pk, flat: 229 dB	49	80	135	230	290

Note: Water Depth 50 m.

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.

Injury to fish from exposures to blast pressure waves is attributed to compressive damage to tissue surrounding the swim bladder and gastrointestinal tract, which may contain small gas bubbles. In order to be exposed to blast pressure that could result in injury or mortality, a sturgeon would need to be within 49-290 m of the UXO being detonated, depending on charge size. Given the dispersed and transient nature of Atlantic sturgeon in the area, the placement of bubble curtains or other noise attenuation system at a distance from the UXO, and that no more than 10 detonations are anticipated over two calendar years, it is extremely unlikely that a sturgeon would be close enough to any detonation to experience injury or mortality.

Given the extremely short duration of a UXO detonations (approximately one second), any behavioral response of sturgeon is expected to be limited to a brief startle and change in swimming direction, with resumption of normal behavior as soon as the explosion is complete. Given the brief exposure, effects to Atlantic sturgeon are so small that they could not be meaningfully measured, detected, or evaluated and are insignificant. Take of Atlantic sturgeon is not anticipated to occur as a result of exposure to UXO detonations.

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 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 New England Wind 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 is the best available data for estimating operational noise of the New England Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA and the nearby Buzzards Bay Buoy, wind speeds are typically less than 30 km/h; 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 6% of the time across a year. 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 New England Wind, this is limited to boomers and sparkers. 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, Appendix C to this Opinion). We summarize the relevant conclusions here. For the equipment proposed for use, the maximum distance to the onset of injury threshold (peak) 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 7.1.38 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	176 dB SEL 207 dB RMS 216 PEAK	3.2	0	708
Sparkers	188 dB SEL 214 dB RMS 225 PEAK	9	0	1,996[a]
Multi-beam echosounder (100 kHz)	185 dB SEL	NA	NA	NA
Multi-beam echosounder (>200 kHz) (mobile, non-impulsive, intermittent)	182 dB SEL	NA	NA	NA
Side-scan sonar (>200 kHz) (mobile, non-impulsive, intermittent)	184 dB SEL	NA	NA	NA

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 boomer is 708m. 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 above for Atlantic sturgeon. However, given that these smaller fish species are more abundant and have a greater biomass throughout the area where increased underwater noise will be experienced, it is possible that there may be some mortality or injury of some forage fish. However, we only expect this to occur as a result of the UXO detonations and not pile driving or other project sound sources. Given that fish would need to be within 290 m of the detonation to be seriously injured or killed (see Table 39 in Hannay and Zykov 2022), and that no more than 10 detonations will occur, any effects to the abundance or distribution of potential fish prey are likely to be so small that they cannot be meaningfully measured, evaluated, or detected. Fish may also react behaviorally to the noise sources discussed here and move away from loud noise sources, such as pile driving and UXO detonations. 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 or UXO detonations 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 exposure to pile driving noise or UXO detonation on 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 New England Wind project. We are not aware of any evidence that pile driving noise, HRG surveys, UXO detonations 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 New England Wind 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 is the best available data for estimating operational noise of the New England Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA and the nearby Buzzards Bay Buoy, wind speeds are typically less than 30 km/h; 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 6% of the time across a year. 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. 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 (i.e., as previously summarized in the *Environmental Baseline,* Section 6 of this Opinion), estimating the anticipated increase in vessel traffic associated with construction, operations, and decommissioning of the project (based on the information provided in BOEM's BA), and then analyzing risk and determining likely effects to listed whales, sea turtles, and Atlantic and shortnose sturgeon. We also consider impacts to air quality from vessel emissions and whether those impacts may cause effects to listed species. In section 3 of this Opinion we described proposed vessel use over all phases of the project as informed by BOEM's BA; that information is summarized here. Effects of project noise, including from vessels, were considered in Section 7.1, and are not repeated here. As considered here, project vessel trips are vessel transits that would not occur but for the proposed action; that is, these are vessels that are operated by Park City, or under contract to Park City, or otherwise engaged in activities that are described in the COP or other project permits, authorizations, or approvals.

Project vessels will operate in distinct areas within the action area over the life of the project. According to the information presented in the BA, the majority, if not all, vessel transits during the construction period will occur between the WDA and ports located between Long Island, NY and New Bedford, MA (referred to here as "Cape Cod to Long Island"). Depending on contracts, port capacity, and other factors, those ports may not accommodate all transits; in that case, some vessel transits may occur between the WDA and ports accessed through New York Harbor (including South Brooklyn Marine Terminal and to Coeymans and Albany in the upper Hudson River). There also may be transits between the WDA and Salem, MA (located on the MA coast north of Boston) as well as transits to Paulsboro Marine Terminal in the Delaware River. There may also be trips from ports in eastern Canada and Europe. See Figure 7.2.1 for locations of ports identified for use in the BA. Transits during the O&M phase will primarily be between the WDA and the O&M facility which is proposed to be located in Bridgeport, CT, Vineyard Haven, MA, New Bedford MA, or Greenport Harbor, NY. We note that if there is an unexpected, non-routine maintenance event, a vessel may travel to the project site from an additional location; however, it is not possible to predict when or where such unanticipated trips may occur and therefore, neither the trips or their effects are reasonably certain to occur and therefore do not meet the definition of "effects of the action" and are not considered here, 50 CFR 402.02; 402.17. As described in the BA, the locations of ports used for decommissioning are unknown at this time; however, we know that vessels supporting decommissioning would operate in and around the WDA. Thus, we have considered an increase in traffic during the decommissioning period in the general area in and around the WDA, including between the WDA and ports identified for use during the O&M phase.

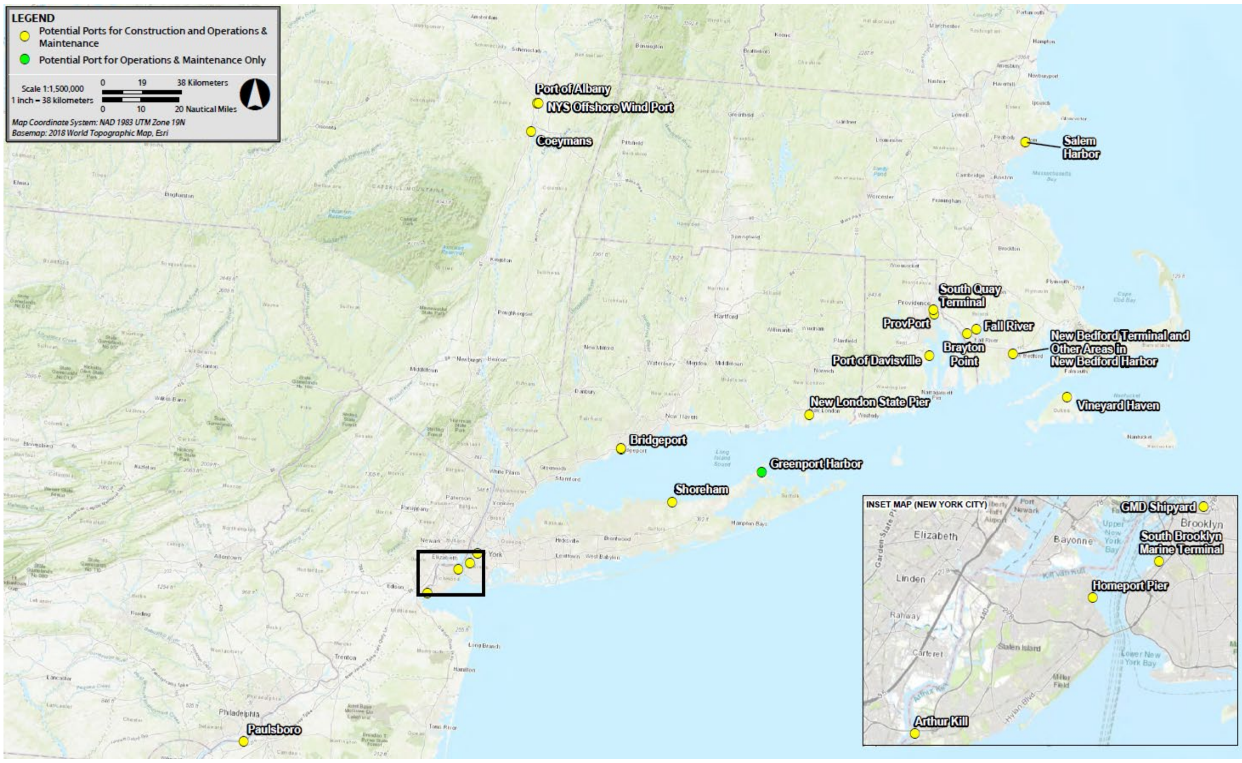


Figure 7.2.1. U.S. Port Facilities under Consideration for Project Construction and Installation and O&M Support (Unidentified ports in Europe and Eastern Canada may also be utilized).
Source: BOEM. 2023. *New England Wind Farm and Export Cable – Development and Operation. COP Figure 3.2-13.*

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 of this Opinion and summarized here for reference. Vessel traffic will occur in the WDA and between the WDA and the ports used to support New England Wind construction, operations and maintenance, and decommissioning; these ports were identified in BOEM's BA. Approximately 60 vessels of various classes will be used during the construction and installation phase with a total of 6,700 vessel trips between various ports and the New England Wind WDA, with an average of 215 round trips per month. During the O&M period, considering both Phase 1 and Phase 2, a total of 470 vessel round trips annually are anticipated, with fewer trips possible if trips can be consolidated across the two projects. Not all vessels will utilize all ports under consideration, the number of possible vessels, approximate length, role, and vessel type is show in Table 7.2.1, and the potential ports to be used during construction is shown in Table 7.2.2.

As explained in Section 3, up to 400 transits of heavy transport vessels may occur between ports in eastern Canada, Europe, and/or the WDA or one of the identified US ports during the construction phase. In this section, we consider the effects of the portion of those vessel transits that are within the U.S. Atlantic EEZ (see explanation in Section 3 of this Opinion).

Table 7.2.1. Potential Vessel Roles, Types, and Estimated Total Number of Vessels to Support Construction Activities and O&M.

Vessel Role	Vessel Type	Number of Vessels	Approximate Length (m)
Foundation Installation			
Scour protection installation	Scour protection installation vessel (e.g. fall pipe vessel)	1	130-170 m
Overseas foundation transport	Heavy transport vessel	2-5	120-223 m
Foundation installation (possibly including grouting)	Jack-up or heavy-lift vessel	1-2	55-220 m
ESP Installations			
ESP installation	Heavy lift vessel	1	154-220 m
Overseas ESP transport	Heavy transport vessel	1-2	120-223 m
Offshore Export Cable Installation			
Cable laying (and potentially burial)	Cable-laying vessel	1-2	80-150 m
Trenching	Cable-laying vessel or support vessel	1	30-150 m
Install cable protection	Cable protection installation vessel (e.g. fall-pipe vessel)	1	80-150 m
Inter-array Cable Installation			
Cable laying (and potentially burial)	Cable-laying vessel	1	80-150 m
Cable installation support	Support vessel	1	30-120m
Trenching	Cable-laying vessel or support vessel	1	30-150 m
Install cable protection	Cable protection installation vessel (e.g. fall-pipe vessel)	1	80-150 m
WTG Installation and Commissioning			
Overseas WTG transport	Heavy transport vessel	1-5	120-223 m
Overseas transport of WTG installation vessel(s)	Heavy transport vessel	1	120-223 m
WTG installation	Jack-up vessel or heavy lift vessel	1-2	55-220 m
Operation and Maintenance (O&M)			
O&M	SOV	26	~80 m
	CTV	52	20-30 m

	Jack-up vessel	1	55-220 m
	Cable-laying vessel	1	80-150 m
	Support barge	1	30-120 m

Source: NEW COP, COP Appendix III-I, and NEW BA

As described in Section 3 (Table 3.12), during the construction phase a variety of vessels will be used including installation and transport vessels that may transit between 4-23 knots (when not subject to a speed restriction); these vessels range from 20 to 223 meters in length (COP Appendix III-I, Table 2.6). The larger installation vessels, such as the floating/jack-up crane, dredging vessels, and cable-laying vessel, will generally travel to and from the construction area in the WDA at the beginning and end of the wind turbine and cable construction/installation and will not make transits to port 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 New England Wind WDA even more frequently. However, we note that construction crews assembling the WTGs may hotel onboard installation vessels at sea thus limiting the number of crew vessel transits expected during wind farm installation. Within the New England Wind WDA, many vessels will be stationary or moving 8 knots or less. Construction of the offshore export cables will utilize various vessel types including a cable-laying vessel, tugs, barges, and work and transport vessels from numerous different ports (see Table 3.10 and Table 7.2.2).

Table 7.2.2. Potential Ports and Usage during the New England Wind Construction and Installation Phase.

	Peak Construction Period	Entire Construction Period	
Ports	Average Round Trips Per Month	Average Round Trips Per Month	Approximate Total Round Trips*
All ports	443	215	6,700
New Bedford Harbor (MA)	443	209	6,500
Bridgeport (CT)	376	177	5,500
Vineyard Haven (MA)			
Port of Davisville (RI)			
South Quay Terminal (RI)			
Port of Providence (RI)	162	68	2,100
Brayton Point Commerce Center (MA)			

Ports	Peak Construction Period	Entire Construction Period	
	Average Round Trips Per Month	Average Round Trips Per Month	Approximate Total Round Trips*
Fall River (MA)			
New London State Pier (CT)			
Staten Island ports (NY)			
South Brooklyn Marine Terminal GMD Shipyard (NY)			
Shoreham (Long Island, NY)			
Salem Harbor (MA – North of Boston)	46	20	610
Canadian ports	38	21	620
European ports	31	13	400
Capital Region ports (Albany, Coeymans, NY) – Hudson River	6	3	100
Paulsboro, NJ – Delaware River			

*The total trips over the construction period is estimated at 6,700 with the identified number of trips in each row the maximum anticipated for each identified group of ports.
Source: BA Table 1-10

During the O&M phase, approximately 470 trips per year to the WDA will occur to carry out inspections and maintenance for Phase 1 and Phase 2 WTGs, ESPs, and cables. The majority of vessel trips over the 30-year O&M period would originate from the O&M facility which is described in the BA as being located in Bridgeport, CT, Vineyard Haven, MA, New Bedford MA, or Greenport Harbor, NY. In the BA, BOEM does not identify that any trips would occur between the WDA and Paulsboro Marine Terminal or the ports in New York Harbor or the Hudson River over the 30-year O&M period. Helicopters may also be used for aerial inspections. Jack-up vessels, cable-lay/cable burial vessels, crew transport vessels, and support barges may be used on an as-needed basis for major repairs. Typical draft and operational speeds for O&M vessel types are expected to be similar to those for equivalent vessels used during construction.

As described in the BA, the number and type of vessels required for project decommissioning would be similar to those used during project construction, with the exception that impact pile driving would not be required. As such, while the same class of vessel used for foundation installation may be used for decommissioning, that vessel would not be equipped with an impact hammer. At this time, no information is available on the ports that may be used for decommissioning; however, based on information presented for other wind projects we expect that trips will occur primarily between the WDA and the ports used for O&M or within the general vicinity of the O&M ports.

Total estimated vessel trips during the 3 to 5-year construction period are 6,700; these trips will be between the New England Wind WDA and the ports identified above. During the decommissioning period, the number and types of vessels required would be similar to those described for the construction and installation period (6,700 trips). As explained in Section 6, the best available information indicates there are approximately 864 vessel tracks annually in the WDA that the majority of New England Wind vessel will conduct work and, based on the USCG MA RI Port Access Route Study, approximately 46,900 unique vessel transits through the area surrounding the WDA in an average year (COP Appendix III-I; USCG MARI PARS 2020). Additional information on vessel traffic in the area is also presented in BOEM's BA. Table 7.2.3 below describes the calculated increase in traffic in this area attributable to New England Wind project vessels during each project phase.

Table 7.2.3. Percent Increase above Baseline Vessel Traffic in the Project Area Due to New England Wind Project Vessels

Phase	Annual Project-Related Vessel Transits	Phase Duration	% Increase in Annual Vessel Transits in the WDA and Surrounding Area[d]
Construction	1,340[a]	5 years	2.86%
O&M	470[b]	30 years	1.00%
Decommissioning	3,350[c]	2 years	7.14%

[a] Source: BOEM 2023 BA (6,700 total trips divided by 5 years of construction)
[b] Source: BOEM 2023 BA (470 maximum trips per year during both phases)
[c] Source: BOEM 2023 BA, (6,700 total trips divided by 2 years of decommissioning)
[d] Source: Baseline vessel traffic in the New England Wind WDA and surrounding area where the majority of project vessels will operate is based on 46,900 transits per year (USCG 2020).

7.2.2 Minimization and Monitoring Measures for Vessel Operations

There are a number of measures that Park City 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 measures incorporated into the proposed action or otherwise required by regulation fall into the following general categories: speed reductions, monitoring for animals in the vessel's path, separation distances between vessels and animals, actions to be taken when an animal is sighted, and increased situational awareness. The complete list of measures that are part of the proposed action is provided in Appendices A, B, and C of this Opinion. The measures described below 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).

Speed Restrictions

As described in the BA, the following speed restrictions will be in place during all phases of the project:

- Year round, all vessels, regardless of size, will comply with 10 knot speed restrictions in any seasonal management area (SMA), dynamic management area (DMA), or slow zone. Note that a portion of the lease area overlaps with the Block Island SMA; other SMAs overlap with other vessel transit routes.
- From November 1 – April 30, all project vessels 65 feet (20 meters) or larger will operate at speeds of 10 knots or less.
- From November 1 – May 14, all vessels, regardless of size, operating within the lease area (all of OCS-A 0534 and any portion of OCS-A 0501 where WTGs, ESPs, or cables are installed), or transiting to or from the lease area will travel at less than 10 knots (note that this includes vessels transiting to/from Salem, MA). Exceptions to this speed restriction are limited to:
    - vessels operating in Nantucket Sound (as North Atlantic right whales are extremely rare in the shallow waters of Nantucket Sound)
    - areas outside of an SMA that are monitored by real-time PAM and/or visual surveys that have confirmed the monitored area is clear of NARW (see additional explanation below)
- All vessels, regardless of size will reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or larger assemblages of whales are observed near an underway vessel.

We note that exceptions to the speed limits may also be made in emergencies when traveling over 10 knots is necessary to ensure the health and safety of vessel crew.

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.

Monitoring and Look Outs

Monitoring and lookouts are required for all project vessels operating in the action area.

- All underway vessels operating at any speed must have a dedicated visual observer on duty at all times to monitor for protected species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). 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.

- 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 (e.g., rain, fog).
- Detection of a marine mammal will trigger appropriate vessel speed reductions and changes in course to avoid close approaches of animals.

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.

As outlined above, vessels in some areas may be exempted from the 10 knot speed restriction otherwise imposed by conditions of COP approval or the MMPA ITA if they are operating in an area that is being monitored by real time PAM and/or visual surveys. As required by BOEM and NMFS OPR, if Park City plans to implement this, they would need to prepare a vessel strike avoidance plan that contained a complete description of their PAM protocols. Details for implementation of the PAM plan were not included in the proposed MMPA ITA or the BA but based on other recent offshore wind projects where PAM was addressed, we expect the following requirements:

- Localized detections of any right whale 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.

We note that any PAM plan will be subject to review and approval by BOEM and NMFS prior to implementation.

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 strike avoidance measures identified in Section 3, 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.

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). Considering the area where project vessels will operate, Atlantic sturgeon may be present in nearshore waters along the U.S. Atlantic coast (depths less than 50 m), including the WDA, and in some rivers and bays that may be transited by Project vessels (i.e., Delaware Bay and Delaware River (Paulsboro Marine Terminal) and New York Harbor and the Hudson River (Ports in Albany and Coeymans, Staten Island, and South Brooklyn Marine Terminal).

Effects of Vessel Transits in the Marine Environment
While Atlantic sturgeon are known to be struck and killed by vessels in rivers and in estuaries adjacent to spawning rivers (e.g., Delaware Bay), we have no reports of vessel strikes in the Atlantic Ocean portion of the action area. 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 WDA and marine waters used by New England Wind vessels.

As established elsewhere in this Opinion, Atlantic sturgeon are present within the WDA (described in Section 6.3) and are transient, not resident, within the WDA and the coastal marine waters that will be transited by project vessels. The dispersed and transient 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 in this portion of the action area 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 marine waters that will be transited by project vessels (with the exception of near shore areas where vessels will dock at ports along the coast of MA, CT, RI, and Long Island, New York) 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 identified in this section to be transited by the project vessels are free flowing with no obstructions; this further reduces the potential for co-occurrence which further reduces the potential for strike. The nearshore areas at the ports along the coast of MA, CT, RI, and Long Island, New York where vessels will enter shallower water and dock are not known to be used by Atlantic sturgeon or Atlantic sturgeon use is expected to be rare; as such, co-occurrence between any Atlantic sturgeon and any project vessels in areas near these landfall sites 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 WDA or transiting in marine waters in New England waters or the New York Bight around the WDA, inclusive of transits along the cable corridors will strike an Atlantic sturgeon during any phase of the proposed project. Therefore, effects to Atlantic sturgeon of project vessels operating in this portion of the action area are discountable.

Project vessels transiting between the WDA and ports accessed through New York Harbor (SBMT, Staten Island, Coeymans, Albany) will enter lower New York Bay. Vessels transiting to SBMT will then travel through the Bay Ridge Channel to Gowanus Bay. From 2013 to 2020, NYSDEC reported 13 Atlantic sturgeon carcasses in New York Bay that had some evidence of a possible vessel strike. These carcasses were not examined and we do not have an estimate of the total number of vessel strikes in this area annually. While we are not able to use these reports to estimate the total number of Atlantic sturgeon struck in this year, the number of carcasses reported and detected in an area that has high volumes of vessel traffic, accessible and well populated shorelines and waterways, and an established reporting system (through the NYSDEC), indicates that risk of vessel strike in this area may be considerably lower than in other geographic areas (e.g., the Delaware River). This may be due to the deep depths of the waterways in this area, the transient nature of Atlantic sturgeon in the New York Harbor/New York Bay area (i.e., sturgeon use of this area is limited to individuals migrating in and out of the Hudson River), and the lack of constrictions that would increase the potential for co-occurrence of deep draft vessels and individual sturgeon.

The best available information indicates there are approximately 85,092 vessel transits annually in the Upper New York Bay, Bay Ridge and Red Hook Channels, and New York Harbor Lower Entrance Channels (i.e., the general area that the majority of New England Wind vessels will transit to/from SBMT or Staten Island). Considering the trips identified in the BA, New England Wind trips (up to 2,100 over a 3 to 5 year period) will represent approximately 0.5-0.8% of vessel transits in this area annually. Given the anticipated low risk of vessel strike in this area, and this very small increase in vessel traffic, it is extremely unlikely that a New England Wind vessel transiting to/from SBMT or Staten Island will increase the risk of vessel strike of Atlantic sturgeon in this area or result in the strike of an Atlantic sturgeon. As such, effects to Atlantic sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to Hudson River Ports (Albany and Coeymans)
Vessels traveling to/from the Port of Albany and the Port of Coeymans will travel up and down the Hudson River. As established elsewhere in this Opinion (described in Section 6.3), Atlantic sturgeon are present throughout the Hudson River from the Albany and Coeymans areas to the mouth of the river. Up to 100 vessel trips over the five-year construction period will transit between Coeymans or Albany and the WDA. The Port of Albany is located 124 miles north of New York Harbor. The Port Coeymans is located 10 miles south of Albany.

While Atlantic sturgeon vessel strikes are known to occur in the Hudson River, the best available information indicates that comparatively, there is less risk of vessel strikes to sturgeon in the Hudson River compared to other rivers because the river is generally wider and deeper than either the Delaware River or the James River (NMFS 2021). Additionally, large vessels, such as those used for the New England Wind project, that transit the Hudson River are typically assisted by tug boats and travel at speeds of less than 1 knot with their propeller idling; this is expected to reduce the risk of vessel strike. The NYSDEC compiles public reports of dead or injured sturgeon and reports those to NMFS. From 2017- July 2023, there were reports of 172 Atlantic sturgeon, with 120 of those reported with injuries that could be indicative of vessel strike. In that same period there were reports of 27 shortnose sturgeon, with 12 of those reported with injuries that could be indicative of vessel strike. There were also 18 reports of sturgeon where species was unreported or undetermined, 3 of those were reported with injuries that could be indicative of vessel strike. Very few reports are salvaged (i.e., collected and evaluated) by NYSDEC or other trained staff. Not all reports are accompanied by photos which makes any determination of species and injuries less reliable. Thus, while we have information reported by NYSDEC, at this time it is not possible to use that data to develop an estimate of the total number of shortnose or Atlantic sturgeon struck by vessels annually in the Hudson River. It is not even clear if the reports represent a reasonably minimum estimate as the uncertainty about species identification and cause of death is based largely on anecdotal reporting by untrained members of the public. However, the data does indicate that some number of Atlantic and shortnose sturgeon are struck by vessels in the Hudson River each year.

In 2018, the USACE WCSC reports a total of 292,748 trips up and down the Hudson River. It is reasonable to use these data when considering the effects of project vessels because this trip count represents an approximate annual average for vessel transits in the Hudson River portion of the action area. The 100 New England Wind vessel trips to the Port of Albany or Coeymans over a three to five-year period (average of 20-30 trips per year for five years), represent approximately 0.034% of the annual commerce-carrying vessel traffic traveling up and down the Hudson River respectively and an even smaller percentage of the total vessel traffic in the area. Given this extremely small increase in vessel traffic and the generally low risk posed by vessel transits in the Hudson River, these trips are unlikely to increase the risk of a vessel strike that would occur absent the New England Wind project. As such, based on this analysis, it is extremely unlikely that a New England Wind vessel transiting to/from the Port of Albany or the Port of Coeymans will result in the strike of an Atlantic sturgeon. As such, effects to Atlantic sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to Paulsboro Marine Terminal

As explained in Section 2.0 and Section 6.0 of this Opinion, NMFS has completed ESA Section 7 consultation on the construction and use of the Paulsboro Marine Terminal. 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. In that Opinion, 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 New England Wind project, BOEM estimates up to 100 trips to the Paulsboro Marine Terminal (see also Table 3.12 in this Opinion). This is approximately 11.4% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, New England Wind 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 11.4% of the total vessel strikes of Atlantic sturgeon could result from New England Wind vessels. Calculating 11.4% of 8 Atlantic sturgeon results in an estimate of 0.9 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the New England Wind project will result in the strike of no more than one Atlantic sturgeon. Based on the proportional assignment of take in the July 2022 Paulsboro Opinion, we expect that this would be no more than one Atlantic sturgeon belonging to the New York Bight DPS.

Summary of Effects of Vessel Operations on Atlantic Sturgeon
Considering all vessel traffic over the life of the project, we anticipate the mortality of no more than one Atlantic sturgeon from the New York Bight DPS. This take is expected to occur as a result of a vessel transiting within the Delaware River or Bay and has been evaluated in the above referenced Biological Opinion issued by NMFS to the USACE for the Paulsboro Marine Terminal.

7.2.3.2 Shortnose sturgeon
The only portion of the action area that overlaps with the distribution of shortnose sturgeon is the estuarine/riverine portions of the vessel transit routes used by vessels transiting Delaware Bay and Delaware River (Paulsboro Marine Terminal) and the Hudson River/New York Harbor (Ports of Albany and Coeymans, South Brooklyn Marine Terminal). As we do not expect shortnose sturgeon to occur in the marine waters transited by project vessels, they will not be exposed to vessel traffic in that portion of the action area.

Effects of Vessel Transits through New York Harbor (Transit to SBMT and Staten Island)
Adult shortnose sturgeon have occasionally been captured in trawl surveys in Upper New York Bay. From 1998-2011, six shortnose sturgeon total were identified in the Harbor Deepening Project (HDP) Aquatic Biological Survey (ABS) program (USACE 2021); from 2003-2017, 19 shortnose sturgeon were collected in the Hudson River Utilities winter trawl survey (unpublished data). The best available information indicates that only rare transient adult shortnose sturgeon are likely to occur in the area transited by vessels traveling to/from the SBMT. We have no evidence of any vessel strikes of shortnose sturgeon in this area. The up to 420 trips annually between SBMT and the WDA during peak construction will represent approximately 0.5% of the annual commerce-carrying vessel traffic traveling through New York Bay and an even smaller percentage of the total vessel traffic in the area. As the vessels will be using existing port facilities, we do not expect there to be an increase in vessel traffic or an increase in the risk of vessel strike. Given this, and the lack of evidence of shortnose sturgeon being struck in this area, it is extremely unlikely that a New England Wind vessel transiting to/from the SBMT will strike a shortnose sturgeon. As such, effects to shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to Hudson River Ports (Albany and Coeymans)
Shortnose sturgeon occur throughout the Hudson River and are most abundant in the freshwater and low salinity reaches of the river (Bain, 1997). As noted above, vessels traveling to/from the Port of Albany and the Port of Coeymans will travel up and down the Hudson River. As with Atlantic sturgeon, shortnose sturgeon vessel strikes are known to occur in the Hudson River. However, the best available information indicates that compared to other rivers (e.g., the Delaware River or the James River), the risk of vessel strike is reduced by the geography and depth of the Hudson River, which does not restrict shortnose sturgeon distribution in the way that narrow or more constricted rivers may.

The 100 New England Wind vessel trips to the Port of Albany or Coeymans represent approximately 0.034% of the annual commerce-carrying vessel traffic traveling up and down the Hudson River respectively and an even smaller percentage of the total vessel traffic in the area. Consistent with the analysis above for Atlantic sturgeon, we do not expect there to be an increase in vessel traffic or an increase in the risk of vessel strike. As such, it is extremely unlikely that a New England Wind vessel transiting to/from the Port of Albany or the Port of Coeymans will result in the strike of a shortnose sturgeon. Therefore, effects to shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to Paulsboro Marine Terminal
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). The 2023 Paulsboro Opinion considered effects of vessels transiting between the mouth of Delaware Bay and Paulsboro on shortnose sturgeon. The 2023 Paulsboro Opinion analyzed an overall amount of vessel transits, of which New England Wind would contribute a small part. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and subsequent use of the Paulsboro Marine Terminal by any vessels was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of one shortnose sturgeon as a result of vessel strike. The Opinion calculated this mortality based on a maximum of 880 vessel trips during the 10-year operational life of the port. As noted above, the New England wind project would result in up to 100 trips to the Paulsboro Marine Terminal. This is approximately 11.4% of the total trips considered in the Paulsboro Biological Opinion. Consistent with the analysis in the Paulsboro Marine Terminal, we consider that all vessels using the port are equally likely to strike a shortnose sturgeon. Calculating 11.4% of 1 shortnose sturgeon results in an estimate of 0.11 vessel struck sturgeon. It is not possible to determine which of the 880 trips to Paulsboro over the 10 year period considered in the Opinion would result in a vessel strike, as such, consistent with the analysis in the Paulsboro Opinion, we consider it equally likely that one of the 100 New England Wind vessel trips will strike and kill a shortnose sturgeon as any of the other vessels transiting to/from the port. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the New England Wind project will result in the strike of no more than one shortnose sturgeon.

Summary of Effects of Vessel Operations on Shortnose Sturgeon
In summary, considering all vessel traffic over the life of the project in the action area, we anticipate vessel traffic related to the New England Wind project to cause the mortality of no more than one shortnose sturgeon in the Delaware River. This take has been evaluated in the above referenced Biological Opinion issued by NMFS to the USACE for the Paulsboro Marine Terminal.

7.2.3.2 ESA Listed Whales

Background Information on the Risk of Vessel Strike to ESA Listed Whales

Vessel strikes from a variety of sizes of commercial, recreational, and military vessels have resulted in serious injury and fatalities to ESA listed whales (Laist et al. 2001, 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 severity 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 knots). 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 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 speed 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 New England Wind WFA overlaps with the Block Island SMA; vessels transiting to the WDA will travel through this SMA, which is in place from November 1 – April 30 each year. Project vessels transiting to ports in New York Harbor and Delaware River/Bay may travel through or adjacent to SMAs near the mouth of New York Harbor and Delaware Bay; these Mid-Atlantic SMAs are in effect from November 1 - April 30 each year. Vessels transiting from Salem, MA would travel near or through the Off Race Point SMA (active March 1 – April 30) and/or the Great South Channel SMA (active April 1 – July 31). Transit through the Cape Cod Bay SMA is not anticipated (active January 1 – May 15). All project vessels will comply with 10 knot speed restrictions within these active SMAs, regardless of vessel size, destination, or origin.

DMAs and acoustically triggered Slow Zones are established in response to aggregations of right whales along the Atlantic Coast; future DMAs and Slow Zones are likely to overlap vessel transit routes and/or the lease area throughout the year. For example, in 2023, NMFS declared a total of 70 Slow Zones/DMAs along the U.S. East Coast (NOAA 2023, pers. Comm.). Of these, 31 were triggered by right whale sightings and 39 were triggered by acoustic detections. Slow Zones/DMAs were declared in 9 locations in the Northeast/Mid-Atlantic U.S. (Martha's Vineyard, MA, Virginia Beach, VA, Portsmouth, NH, Nantucket, MA, Boston, MA, Portland, ME, Ocean City, MD, New York Bight, NY, and Atlantic City, NJ) and in one location in the Southeast U.S. (Outer Banks, NC). As described in the BA, BOEM will require that New England Wind vessels of any size travel at speeds of 10 knots or less in any SMA, DMA or Slow Zone triggered by visual detections in all project phases; and the proposed MMPA ITA will require vessels of any size travel at speeds of 10 knots or less in any SMA, DMA or any acoustically triggered slow zone 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.

Effects of Vessel Transits in the New England Wind WDA and to/from Ports from Cape Cod to New York Harbor
Here we consider the risk of vessel strike to sea turtles from project vessels transiting between the New England Wind WDA (lease area and cable corridors) and the identified ports in southern New England (i.e., south of Cape Cod) and New York. Trips between the WDA and Salem, MA and Paulsboro, NJ as well as trips within the U.S. EEZ by vessels transiting from Canada and Europe are addressed following this section.

To assess risk of vessel strike in the area where the majority of vessel traffic will occur (i.e., the WDA and the vessel transits routes south of Cape Cod through New York Harbor) we carried out a four-step process. First, we use the best available information to describe the existing records of vessel strike of right, fin, sei, sperm, and blue whales in that geographic area (i.e., south of Cape Cod to New York Harbor). Second, we used the best available information on baseline traffic (i.e., the annual number of vessel transits within that geographic area absent the proposed action) and the information provided by BOEM and Park City on the number of anticipated vessel transits in that area by New England Wind project vessels to determine to what extent vessel traffic would increase in this geographic area during each of the three phases of the New England Wind project. For example, if baseline traffic was 100 trips per year and the New England Wind project would result in 10 new trips in that area, 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 that geographic area would lead to a proportional increase in vessel strike risk), we consider how, absent any avoidance or minimization measures, risk of vessel strike may increase in the area of concern. For example, if we predicted a 10% increase in vessel traffic we would consider that, absent any avoidance or minimization measures, the risk of vessel strike would increase by 10%. It is important to note that these steps were carried out without consideration of any measures designed to reduce vessel strike and the reasonable assumption that all vessels have the same likelihood of striking a whale. 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 (from relevant USCG Port Access Route studies, as cited herein) and Project vessel transits (described in BOEM's BA) were used to evaluate the effects of vessel traffic on listed species in the action area as this provides the most accurate representation of vessel traffic in the action area 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. Additionally, while we can determine the straight line distance between any two points (e.g., Bridgeport, CT and any particular point within the WDA), we do not know the exact routes that any vessel will take as that is influenced by weather, sea state, routing around SMAs or DMAs, and a number of other factors that would make predicting the vessel miles for any individual transit, or all anticipated transits, inexact and unreliable. 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 in a more accurate assessment of the risk of adding the New England Wind 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.

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 New England Wind WDA and identified ports in MA, RI, CT, NJ, and NY (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 in Section 6. Vessel traffic between the WDA and ports in MA, RI, CT, NJ and NY accounts for at least 75% of the anticipated vessel traffic during the construction phase (dependent on the actual ports used) and up to 100% of the anticipated traffic during the construction, operations and maintenance, and decommissioning phases.

We reviewed the best available data for the period since the 2008 vessel strike rule was implemented from the marine mammal stock assessment reports and serious injury and mortality reports produced by NMFS, for the period of 2011-2020 ((Henry et al. 2015 for 2009-2010 data, Henry et al. 2017 for 2011-2015 data, Henry et al. 2022 from 2016-2020 data; these are the most recent reports available), we did not identify any records of mortality of ESA listed whales consistent with vessel strike that were first detected in waters of southern New England (Connecticut, Rhode Island and, Massachusetts - south of Cape Cod), Long Island Sound, and eastern edge of Long Island, New York which is the best representation of the geographic area representing the New England Wind WDA, and the area where vessels will transit between these areas and the identified ports in Massachusetts, Rhode Island, Connecticut, and New York (Long Island Sound). In 2010, there was one fin whale (calf) first observed 24.3 nm E of Montauk with two healed propeller scars; given that these injuries were healed we do not consider this as a report of a vessel strike in the geographic area considered here (Henry et al. 2015). We also reviewed the sources identified here to identify any records of mortality of ESA listed whales consistent with vessel strike that were first detected in waters of New York from the Ambrose to Hudson Canyon traffic lane along the southern coast of Long Island to capture the area where vessels transiting between the WDA and New York Harbor would travel. In 2014 and 2016, there was one fresh sei whale carcass documented on the bow of a vessel in the port of New York/New Jersey (Henry et al. 2017 and Henry et al. 2022). There is also a May 2017 report of fresh fin whale carcass on the bow of a 656' vessel docking at Port Newark, NJ (Henry et al. 2022); speed and location of strike are reported as unknown. There were no other reports of fin, sei, sperm, blue, or right whales with vessel strike injuries in this area for the time period considered. As noted above, in some scenarios, this area would account for nearly all of the vessel traffic associated with the New England Wind project. We also reviewed NMFS records post-dating 2020, including information from the right whale UME (as posted through February 5, 2024), and did not identify any records of vessel strikes in this area. However, we note that multiple vessel strikes of sei, fin and right whales have occurred in this period in waters outside the geographic area considered here (Hayes et al. 2022, Henry et al. 2017, Henry et al. 2022).[42] Additionally, we note that the location of where a vessel strike occurs is not always known and the location the animal is first documented may not be the location where the strike occurred. As such, it is difficult to identify a number of strikes of any of these species that has occurred in the geographic area of interest since 2008.

Absent any mitigation measures we would generally expect an increase in risk proportional to the increase in vessel traffic. As such, this would increase risk during the construction period by 2.86%, during the operations and maintenance period by 1.00%, and by 7.14% during the decommissioning period. As noted above, the only records of ESA listed whales with injuries consistent with vessel strike that were first documented in the area of interest were two sei whales and one fin whale observed on the bows of ships in the Port of New York/New Jersey. There is no information available on where these whales were struck. In the portions of this area that overlap with high areas of vessel traffic (i.e., the existing SMAs) risk of vessel strike, particularly for right whales, is generally considered higher than in other areas with lower levels of vessel traffic. Blue, sei, and sperm whales are typically found in deeper waters of the continental shelf, and are expected to be rare in the New England Wind 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 New England Wind WDA.

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 in areas and at times of year when risk of strike is considered highest, monitoring via dedicated visual observers, PAM, and alternative monitoring technologies to be used at night or in other low visibility conditions to improve detection of whales in time to slow down and avoid a strike.

The vessel speed limit requirements proposed by 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 above and in Appendices A and B of this Opinion, specific measures related to vessel speed reduction will be in place for vessels, regardless of size, transiting in SMAs whenever active, DMAs/Slow Zones year round, and for all vessels, regardless of size operating within the lease area or to/from the lease area from November 1- May 14. Additionally, any other project vessels, 65 feet in length or greater,

[42] https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event; last accessed 1/17/2024

operating outside of those areas (e.g., from one port to another) would travel at 10 knots or less between November 1 and April 30. The only exceptions to these speed restrictions are in emergencies and if a vessel otherwise subject to a project related speed restriction (i.e., not a speed restriction required through regulation, such as a vessel 65' or larger in an active SMA per the current vessel speed rule), is operating pursuant in an area being monitored by PAM consistent with a NMFS and BOEM approved vessel strike avoidance plan submitted by Park City that the agencies concur provides an equivalent level of protection to a 10 knot speed restriction Year round, all underway vessels will have a dedicated visual observer to monitor for protected species, with that lookout having no other duties when the vessel is transiting at speeds greater than 10 knots.

Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2004 Laist et al. 2001). An analysis by Vanderlaan and Taggart (2007) 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, 2004; 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 (2004) 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 or vessel operator is a 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 vessel and include dedicated visual observers 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, use of alternative monitoring technology (such as night vision) to improve detectability of large whales in low visibility conditions, and additional measures as outlined in the proposed MMPA ITA and BA. 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 potential increase in vessel strike due to increases in vessel transit caused by the proposed action is 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 potential for effective detection and avoidance.

Vessel speed restrictions:

As explained above, a 10 knot speed restriction will be in place for all project vessels 65' and greater from November 1 to April 30 operating anywhere in the action area and for all project vessels, regardless of size operating from November 1 to May 14 in the lease area, along the cable corridor, or between any port and the WDA. The only exceptions are emergencies (i.e., there is a threat to human life or safety, such as a medical emergency on board that necessitates quick access to emergency medical services on shore) and when the vessel is operating in a "transit corridor" being monitored by real-time PAM, when no right whales have been detected in the previous 12 hours and when there is no overlap with an active SMA or Slow Zone/DMA. The November - April period is the time of year when North Atlantic right whales are most likely to occur in the area transited by project vessels being considered here and covers the months when density is highest. Vessels of all sizes will also comply with a 10 knot speed limit in any SMA, DMA/visually triggered Slow Zone, and in any low visibility conditions where monitoring at least 500 m from the vessel is impaired. For all project phases, year round, all underway vessels operating at greater than 10 knots will have a dedicated visual observer to monitor for protected species and implement mitigation measures as necessary. Vessels would also be required to slow to 10 knots or less any time a large whale (of any species) is observed within 500 m of a 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.

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 dedicated visual observer observes an animal in the path of a vessel and therefore reduces the likelihood of any strike occurring at all.

The period of time and areas when vessels can travel at speeds greater than 10 knots are at times when North Atlantic right whales are expected to occur in very low numbers and thus the risk of a vessel strike is significantly lower. As noted above, PAM will be used to monitor for the presence of vocalizing whales in a defined transit corridor. Travel above 10 knots will only occur in "transit corridors" 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. 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 all instances, PSOs/lookouts will be monitoring a vessel strike zone, see below.

<u>Dedicated Visual Observers and Increased right whale awareness:</u>
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, including ESA-listed whale species. During any vessel transits within or to/from the New England Wind WDA, a dedicated visual 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 dedicated visual observer 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 along with a real-time PAM. 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 meters away from any right whale or unidentified large whale. If any whale is detected within 500 meters 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, if a vessel is traveling at greater than 10 knots, in addition to the required dedicated visual observer and real-time PAM, all vessel operators will monitor WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales. The dedicated visual observer 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 dedicated visual observer and PAM teams. All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (Slow Zones/DMAs 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.

Summary of Effects of Vessel Transits to/from Ports South of Cape Cod to New York Harbor
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 likely 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.

Given the more offshore distribution of sei, blue, and sperm whales and the low density of these species in this geographic area, we expect that the potential for co-occurrence of an individual of one of these species with a New England Wind vessel operating in this area is extremely unlikely. The required minimization measures outlined above are effective at further reduce this risk. As such, effects to sei, blue, and sperm whales from the operation of New England Wind vessels in this area are discountable.

Given the location of the New England Wind WFA in the center of the MA/RI WEA and the area where vessel transits will occur to/from ports in MA, RI, CT, NJ, NY, and the WDA, vessels will be transiting in areas where right whale sightings and predicted density are lower than other areas in southern New England. Combined with the already very low increased risk of vessel strike anticipated due to increased project vessel traffic, we expect that the measures that are specifically designed to reduce risk of project vessels striking a right whale will further reduce that risk and make it extremely unlikely that a Project vessel will strike a right whale. Therefore, effects to right whales from the operation of New England Wind vessels in this area are discountable.

As described above, given the inshore coastal areas where Project vessels will be transiting, fin whale predicted density is low, thus there is a low likelihood for co-occurrence. Additionally, there are no reports of vessel strikes of fin whales in this geographic area between 2011 and 2020. Combined with the already very low increased risk of vessel strike anticipated due to increased project vessel traffic, we expect that the measures that are designed to reduce risk of project vessels striking fin whales will effectively reduce that risk further and make it extremely unlikely that a Project vessel will strike a fin whale. Therefore, effects to fin whales from the operation of New England Wind vessels in this area are discountable.

Effects of Vessel Transits between the WDA and Paulsboro, NJ
During the three to five-year construction phase, New England Wind anticipates up to 100 vessel trips between the WDA and the Paulsboro Marine Terminal, NJ. These vessels would include heavy transport vessels, heavy installation vessels, guard/scout vessels, pre-lay grapnel run vessels, supply barges, and survey vessels. These vessels are subject to the vessel speed

restrictions outlined above. Additionally, these vessels will have dedicated visual observers monitoring for whales. Vessels transiting between these ports and the New England Wind WDA are expected to travel in shipping lanes when entering/leaving port and then transit offshore along typical commercial vessel transit routes.

As described in Section 6 of this Opinion, ESA listed whales occur in this area in varying distributions and abundances throughout the year. North Atlantic right whales occur in the area primarily in the fall and early spring, as some individuals in the population migrate through the Mid-Atlantic to the Southeast calving grounds. 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 typically in northern Mid-Atlantic waters, primarily during the fall, winter, and spring. Sperm whales along the Mid-Atlantic are found offshore along the shelf break year-round. Blue whales are typically found further offshore in areas with depths of 100 m or more. 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.

Project vessels will represent an extremely small portion (up to 100 total trips over the three to five-year construction period) of the vessel traffic traveling through Mid-Atlantic waters to/from the New England Wind WDA. Considering, an estimated 74,000 vessel transits a year occur in the Mid-Atlantic area, this is about a 0.14% increase in traffic in this area, assuming that all of these trips represent "new" trips for vessels that otherwise would not be operating in this area and all 100 trips occurred in one year. Given that with few exceptions, these vessels will be traveling at speeds of 10 knots or less year-round and will be in compliance with vessel strike regulations, and have lookouts monitoring for whales, and in consideration of the extremely small increase in vessel traffic in this portion of the action area that these vessels will represent, it is extremely unlikely that any ESA listed whales will be struck by a project vessel operating in this portion of the action area. Therefore, effects to right, fin, sei, blue, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Effects of Vessel Transits to/from Ports in Salem, MA and the New England Wind WDA
During the three to five-year construction phase, New England Wind anticipates up to 610 vessel trips between the WDA and ports in Salem, MA. These vessels would include heavy transport vessels, heavy installation vessels, guard/scout vessels, pre-lay grapnel run vessels, supply barges, and survey vessels. Vessels transiting between Salem, MA and the New England Wind WDA are expected to travel in the Boston traffic separation scheme outside of Cape Cod and then transit to the lease area. Some of these vessels are capable of transit speeds of up to 23 knots; however, all vessels traveling between Salem, MA and the WDA would reduce speed to 10 knots in any SMA or DMA/Slow Zone as noted above. Moving south from Salem, vessels would be subject to the Off Race Point SMA from March 1 – June 30, the Great south Channel SMA from April 1 – June 30 and the Block Island SMA (overlaps a portion of the WDA) from November 1 – April 30. Additionally, all vessels 65' or greater (the likely size of vessels traveling this distance) would travel at 10 knots or less from November 1 – April 30 even outside these SMAs. The only exception from these speed restrictions are emergencies (crew health/safety) and if there is a PAM monitored vessel transit corridor, in which case outside of

SMAs or DMAs, a vessel could travel above 10 knots when no whales had been detected by PAM for at least 12 hours.

As described in Section 6 of this Opinion, ESA listed whales occur in this area in varying distributions and abundances throughout the year, and North Atlantic right whale critical habitat is located in this area. North Atlantic right whales occur in the area year round, most notably around Nantucket Shoals. Based on detections from aerial surveys and PAM deployments within the RI/MA WEA, right whales are expected in the WDA in higher numbers in winter and spring followed by decreasing abundance into summer and early fall. 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 typically in northern Mid-Atlantic waters, primarily during the fall, winter, and spring. Sperm whales along the Mid-Atlantic are found offshore along the shelf break year-round. Blue whales are typically found further offshore in areas with depths of 100 m or more. 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.

Project vessels will represent an extremely small portion (up to 610 total trips over the three to five-year construction period) of the vessel traffic traveling in the area between Salem, MA and the New England Wind WDA. Information from the USCG's 2023 Port Access Route Study: Approaches to Maine, New Hampshire, and Massachusetts indicates that there are thousands of vessel transits per year in this area. Considering just the vessel transits in the identified cross sections between Salem and Boston (Coastwise, Between Boston Harbor and Gloucester; North of Boston Harbor TSS, and TSS, Boston Harbor), there were an average of 3,206 vessel tracks annually between 2019 and 2021 (USCG 2023, Enclosure 1). At an average of 120-200 trips per year, this will be a very small increase in traffic in this area (less than 6%, noting that not all vessel transits are recorded in the USCG PARS). Given that with few exceptions, these vessels will be traveling at speeds of 10 knots or less year-round and will be in compliance with vessel strike regulations, and have lookouts monitoring for whales, and in consideration of the extremely small increase in vessel traffic in this portion of the action area that these vessels will represent, it is extremely unlikely that any ESA listed whales will be struck by a project vessel operating in this portion of the action area. Therefore, effects to right, fin, sei, blue, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Effects of Vessel Transits in the U.S. EEZ East and North of the New England Wind WDA
Due to project component and vessel availability, a small number of vessels will transit from ports in eastern Canada, and Europe to the New England Wind WDA; this section considers those vessel transits while in the U.S. EEZ. These vessels will be heavy transport vessels, during transit these vessels may travel up to 13.5 knots with speed of less than 10 knots more typical. BOEM has indicated that during the entire five-year construction period there may be up to 400 vessel transits from ports in Europe to the U.S., and up to 620 trips expected to travel from ports in eastern Canada before traveling to the WDA or local ports in the U.S. Project vessels will represent an extremely small portion of the vessel traffic traveling through the EEZ. In this portion of the action area, co-occurrence of project vessels and individual whales is expected to be extremely unlikely; this is due to the dispersed nature of whales in the open ocean and the

only intermittent presence of project vessels (1,020 transits over a five year period). When operating outside of an active SMA or Slow Zone/DMA, these vessels could operate at speeds over 10 knots; however, they will have a dedicated lookout monitoring for whales and will be required to slow down (to 10 knots or less), stop their vessel, or alter course (as appropriate) to avoid getting within 500 m of any whale. Given the limited amount of vessel trips in this area (i.e., up to 1,020 trips over a five-year period), the dispersed nature of whales in this offshore area, and the limited potential for co-occurrence of a whale and one of these vessels, it is extremely unlikely that any ESA listed whales will be struck by a project vessel during one of the no more than 1,020 transits within the U.S. EEZ on its way to or from ports in eastern Canada, and Europe. The requirements for lookouts and to slow down if whales are observed would further decrease this risk. Therefore, effects to right, fin, sei, blue, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Summary of Effects of Vessel Traffic on ESA Listed Whales
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, blue, or sperm whale during any phase of the proposed project. Therefore, effects to right, fin, sei, blue, and sperm whales from vessel strike due to project vessels operating in the action area are discountable.

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 New England Wind WFA and the transit routes to ports in southern New England and New York 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.

Effects of Vessel Transits in the New England Wind WDA and to/from Ports from Cape Cod to New York Harbor
Here we consider the risk of vessel strike to sea turtles from project vessels transiting between the New England Wind WDA (lease area and cable corridors) and the identified ports in southern New England (i.e., south of Cape Cod) and New York. Trips between the WDA and Salem, MA and Paulsboro, NJ as well as trips within the US EEZ by vessels transiting from Canada and Europe are addressed following this section.

To inform our consideration of the baseline vessel strikes of sea turtles in this area, we carried out two queries of 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). One for records in Long Island Sound, Long Island forks, Rhode Island coast, Massachusetts coast from Massachusetts/Rhode Island border to the eastern extent of Vineyard Sound, defined by a line from East Chop to Succonnesset Point (Territorial Sea line on NOAA Chart 13237), inclusive of Narragansett and Buzzards Bays, from 2013 to 2022. We selected this geographic area as it represents the waters that will be transited by the majority of project vessels traveling to/from the WDA and the ports identified in New England and Long Island Sound. The results from this query are presented in Table 7.2.4.

We also queried the NMFS' 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 the New York Bight region (i.e. NMFS statistical area 612) from 2013 to 2022. We selected this geographic area as it includes the waters that will be transited by project vessels traveling to/from the WDA and New York Harbor, inclusive of the SBMT and Staten Island. While it is larger than the area where those vessel transits will occur, this area is considered the best representation of the area where sea turtles struck by vessels operating in that area would strand. The results from this query are in Table 7.2.6.

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). 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 Table 7.2.4, for loggerheads, we first added the "definitive vessel" (64) and "blunt force trauma" (17) then multiplied that value (81) by 0.93 (=75)). 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 the Long Island Sound and Southern New England Region and Estimated Presumed Vessel Mortalities.

Sea Turtles	Total Records	Definitive Vessel	Blunt Force Trauma	Total Presumed Vessel Mortalities*
NWA DPS Loggerhead sea turtle	232	64	17	75
NA DPS Green sea turtle	21	3	2	4.65
Leatherback sea turtle	178	56	6	58
Kemp's ridley sea turtle	47	4	1	4.65

Source: STSSN (December, 2023)
* 93% of the total of "definitive vessel" plus "blunt force trauma"

Table 7.2.5. Preliminary STSSN cases from 2013 to 2022 with evidence of propeller strike or probable vessel collision in the New York Bight region and estimated presumed vessel mortalities.

Sea Turtles	**Total Records**	**Definitive Vessel**	**Blunt Force Trauma**	**Total Presumed Vessel Mortalities***
NWA DPS Loggerhead sea turtle	266	108	25	123.69
NA DPS Green sea turtle	16	5	0	4.65
Leatherback sea turtle	43	17	4	19.53
Kemp's ridley sea turtle	47	13	3	14.88

Source: STSSN (July 2023)
*93% of the total vessel plus blunt force trauma

The data in Table 7.2.4 and 7.2.5 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., Peckham 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 percent. The resulting, adjusted number of vessel strike mortalities of each species in the Long Island Sound and southern New England region (Table 7.2.6) and New York Bight (Table 7.2.7) are presented in the "annual total presumed vessel mortalities" column in Table 7.2.6 and Table 7.2.7. We note that the 17 percent correction factor considers 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%) 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. At this time, we do not have any information to indicate that this is not a reasonable conclusion.

Table 7.2.6. Estimated Annual Vessel Strike Mortalities Corrected for Unobserved Vessel Strike Mortalities in the Long Island Sound and Southern New England Region.

Sea Turtles	Presumed Vessel Mortalities* Over 10 years	Total Over 10 Years (17% Detection Rate)	Annual Total Presumed Vessel Mortalities
NWA DPS Loggerhead sea turtle	75	441	44.1
NA DPS Green sea turtle	5	29	2.9
Leatherback sea turtle	58	341	34.1
Kemp's ridley sea turtle	5**	29	2.9

* 93% of the total of "definitive vessel" plus "blunt force trauma"
** Rounded up from Table 7.2.4

Table 7.2.7. Estimated Annual Vessel Strike Mortalities Corrected for Unobserved Vessel Strike Mortalities in the New York Bight region

Sea Turtles	**Presumed Vessel Mortalities* Over 10 Years**	**Total Over 10 Years (17% detection rate)**	**Annual Total Presumed Vessel Mortalities**
NWA DPS Loggerhead sea turtle	124	729	73
NA DPS Green sea turtle	5	29	2.9
Leatherback sea turtle	20	118	11.8
Kemp's ridley sea turtle	15	88	8.8

* 93% of the total of "definitive vessel" plus "blunt force trauma"

To estimate the number of vessel strikes that may result from the proposed project, we considered the phase-specific increase in vessel traffic and calculated the expected increase in vessel strikes proportional to the increase in project vessel traffic. For these calculations, we assume a proportional relationship between vessel strikes and vessel traffic. The formula used to generate the estimate of project vessel strikes over the construction, operations, and decommissioning phases is: (annual baseline strikes)*(% increase in traffic)*(years of project phase). Note that the calculations illustrated here consider a 5 year construction period, a 30 year operational period, and two year decommissioning period; while an accelerated 3-year construction period may occur, this just distributes trips differently over time and does not result in any differences in the total calculations.

In the BA BOEM presents the total trips anticipated during each project phase and the volume of traffic to various ports; however, as final selections for ports have not yet been made BOEM presents an array of options. The two primary scenarios anticipated in the BA are that either nearly all of the 6,700 vessel transits will occur between the WDA and the identified ports in southern MA, CT, RI, and Long Island or alternatively, that up to 2,200 of those trips could occur between the WDA and ports adjacent to New York Harbor (i.e., Staten Island and/or South Brooklyn Marine Terminal). The calculations that follow are based on all 6,700 trips occurring between the WDA and the identified ports in southern MA, CT, RI, and Long Island.

Construction = 2.86% increase in traffic for 5 years

Loggerhead sea turtles: (44.1)(0.0286)(5) = 6.31 loggerhead sea turtles

Green sea turtles: (2.9)(0.0286)(5) = 0.42 green sea turtles

Leatherback sea turtles: (34.1)(0.0286)(5) = 4.88 leatherback sea turtles

Kemp's Ridley sea turtles: (2.9)(0.0286)(5) = 0.42 Kemp's Ridley sea turtles

Operation = 1.00% increase in traffic for 30 years

Loggerhead sea turtles: (44.1)(0.01)(30) = 13.23 loggerhead sea turtles

Green sea turtles: (2.9)(0.01)(30) = 0.87 green sea turtles

Leatherback sea turtles: (34.1)(0.01)(30) = 10.23 leatherback sea turtles

Kemp's Ridley sea turtles: (2.9)(0.01)(30) = 0.87 Kemp's Ridley sea turtles

Decommissioning = 7.14% increase in traffic for two years

Loggerhead sea turtles: (44.1)(0.0714)(2) = 6.30 loggerhead sea turtles

Green sea turtles: (2.9)(0.0714)(2) = 0.41 green sea turtles

Leatherback sea turtles: (34.1)(0.0714)(2) = 4.87 leatherback sea turtles

Kemp's Ridley sea turtles: (2.9)(0.0714)(2) = 0.41 Kemp's Ridley sea turtles

As explained above, any trips to the NY Harbor area ports during the construction period would reduce traffic to ports to the north. If all 2,100 trips occurred to these ports, this would reduce trips to the northern ports by about one-third. Based on the estimated turtle strikes estimated above, the rate of strike appears to be similar in the two geographic areas (e.g., as outlined below we calculate up to 2 strikes of loggerhead sea turtles for the NY Harbor ports for about 1/3 of the total construction vessel traffic, this is about 1/3 the 6.3 loggerhead strikes calculated if all traffic went to the northern ports). As such, we consider the estimate of strike to the ports between Cape Cod and Long Island to be a reasonable estimate of strikes that would occur for all trips between Cape Cod and New York Harbor.

Using the same formula as above, and considering 2,100 trips over a 5-year construction period, we calculate the following:

Construction = 0.49% increase[43] in traffic for 5 years

Loggerhead sea turtles: (73)(0.0049)(5) = 1.78 loggerhead sea turtles

Green sea turtles: (2.9)(0.0049)(5) = 0.07 green sea turtles

Leatherback sea turtles: (11.8)(0.0049)(5) = 0.29 leatherback sea turtles

Kemp's Ridley sea turtles: (8.8)(0.0049)(5) = 0.22 Kemp's Ridley sea turtles

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 7.2.8 below:

Table 7.2.8. Estimate of Sea Turtle Vessel Strikes from Project Vessels Operating south of Cape Cod to Long Island.

Species	Maximum Vessel Strike Anticipated
NWA DPS Loggerhead sea turtle	28
NA DPS Green sea turtle	2
Leatherback sea turtle	22
Kemp's ridley sea turtle	2

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.

Sea turtles are only present seasonally in this portion of the action area, primarily between June and October with a few individuals present earlier in the spring and few present through November. The calculations presented above do not reflect any consideration of the seasonal use of the action area which would limit the period each year where there is a risk of vessel strike. At this time we do not have sufficient data to adjust these calculations to account for the seasonal presence of sea turtles; this is largely because we do not have monthly estimates of project or baseline vessel traffic. We also note that it is likely not reasonable to assume even distribution of

[43] 2,100 trips over 5 years = approximately 420 trips/year which is an 0.49% increase over the baseline of 85,092 trips annually. The best available information indicates there are approximately 85,092 vessel transits annually in the Upper New York Bay, Bay Ridge and Red Hook Channels, and New York Harbor Lower Entrance Channels (i.e., the general area that the majority of Empire Wind vessels will transit to/from SBMT) (Empire Wind COP Appendix DD).

trips over the year due to seasonal limits on some activities (e.g., pile driving). Therefore, while acknowledging that these may be overestimates we consider them reasonable predictions of the amount of vessel strike that is likely to result from the increase in vessel traffic attributable to the New England Wind project.

As explained above in Section 7.2.2, New England Wind 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 dedicated visual observers, slowing down if a sea turtle is sighted at any distance of the forward path of the operating vessel, the vessel operator must steer 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.

Effects of Vessel Transits between the WDA and Paulsboro, NJ
In the BA, BOEM estimates up to 100 trips between the WDA and Paulsboro, NJ over the 5 year construction period. As described in Section 6, ESA listed sea turtles occur in this area in varying distribution and abundance throughout the year, with a notable seasonal pattern. All listed sea turtle species have a seasonal migration where they move into more northerly waters (i.e. northern Mid-Atlantic, southern New England, parts of the Gulf of Maine) during the summer and then migrate back through the Mid-Atlantic to more southern areas through the fall and occur there throughout the spring. During Project vessel transits to ports in the Mid-Atlantic, in the deeper offshore waters of the action area, the species and age classes most likely to be impacted are hatchlings and pre-recruitment juveniles of all sea turtle species, all age classes of leatherback sea turtles, and occasionally adult loggerheads. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among Sargassum mats. 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. In general, ESA listed sea turtles are expected to be highly dispersed in offshore waters on the continental shelf and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low. Project vessels have the greatest chance to co-occur with sea turtles in the nearshore waters as vessels enter Delaware Bay (to transit to Paulsboro); however, in these areas vessels are expected to be traveling slowly which is expected to decrease the risk of vessel strike.

Project vessels transiting to Paulsboro will represent an extremely small portion (up to 100 trips over the three to five year construction period) of the vessel traffic traveling through Mid-Atlantic waters to/from the New England Wind WDA. Considering, an estimated 74,000 vessel transits a year occur in the Mid-Atlantic area, this is about a 0.14% increase in traffic in this area, even if all trips occurred in a single year and assuming that all of these trips represent “new” trips for vessels that otherwise would not be operating in this area. Given this extremely small increase in vessel traffic, any increased risk of vessel strike of sea turtles is also extremely small. As such, we expect that New England Wind vessels operating in this portion of the action area are extremely unlikely to strike any sea turtles; therefore, effects of vessel traffic on sea turtles by vessel strike in this portion of the action area are discountable.

Effects of Vessel Transits to/from Ports in Salem, MA and the New England Wind WDA
During the three to five-year construction phase, New England Wind anticipates up to 610 vessel trips between the WDA and ports in Salem, MA. These vessels would include heavy transport vessels, heavy installation vessels, guard/scout vessels, pre-lay grapnel run vessels, supply barges, and survey vessels. Vessels transiting between Salem, MA and the New England Wind WDA are expected to travel in the Boston traffic separation scheme outside of Cape Cod and then transit to the lease area.

Sea turtles are seasonally present north of Cape Cod, but in lower densities. Sea turtles are expected to be highly dispersed in these waters and, the likelihood of co-occurrence between project vessels and sea turtles is low.

Project vessels will represent a small portion (up to 610 total trips over the three to five-year construction period) of the vessel traffic traveling in the area between Salem, MA and the New England Wind WDA. Information from the USCG's 2023 Port Access Route Study: Approaches to Maine, New Hampshire, and Massachusetts MA indicates that there are thousands of vessel transits per year in this area. At an average of 120-200 trips per year, this will be a very small increase in traffic in this area. Given the low density of sea turtles in this portion of the action area, their seasonal presence, and the small increase in vessel traffic that will result from New England Wind vessel trips between the WDA and Salem, any increase in risk of vessel strike in this area is expected to be extremely small such that vessel strike is extremely unlikely to occur and therefore, effects are discountable.

Effects of Vessel Transits in the U.S. EEZ East and North of the New England Wind WDA
Due to project component and vessel availability, vessels will transit from ports in eastern Canada to the New England Wind WDA; this section considers vessel transits through the U.S. EEZ. These vessels will be heavy transport vessels, during transit these vessels may travel up to 13.5 knots when not subject to vessel speed restrictions that would limit speed to 10 knots. BOEM has indicated that during the entire five-year construction period there may be up to 400 vessel transits from ports in Europe to the U.S., and up to 620 trips expected to travel from ports in eastern Canada before traveling to the WDA or local ports in the U.S. Project vessels will represent an extremely small portion of the vessel traffic traveling through the EEZ during this period of time. In this portion of the action area, co-occurrence of project vessels and individual sea turtles is expected to be extremely unlikely; this is due to overall low abundance and limited seasonal occurrence of sea turtles in this portion of the action area, the dispersed nature of sea turtles in the open ocean, and the only intermittent presence of project vessels. Based on this, it is extremely unlikely that any sea turtles will occur along the vessel transit route at the same time that a project vessel is moving through the area. Together, this makes it extremely unlikely that any ESA listed sea turtles will be struck by a project vessel. Therefore, effects of vessel transits on sea turtles by vessel strike in this portion of the action area are discountable.

Summary of Effects of Vessel Traffic on ESA Listed Sea Turtles
In summary, we expect that the operation of project vessels over the life of the proposed action (i.e., 37 years) will result in the strike and mortality of up to 28 loggerhead, 2 green, 22 leatherback, and 2 Kemp's ridley sea turtles.

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 Safety Risk Assessment ("NSRA" see COP Appendix III - I), the proposed WTG spacing is sufficient to allow the 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 ESPs 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.

Currently, vessel traffic in the New England Wind WDA is primarily recreational vessels and fishing vessels which transit the area in non-uniform patterns. Larger vessels such as cargo, tug, or tanker vessels transit the New England Wind WDA infrequently as these larger vessels primarily transit the Nantucket to Ambrose TSS and TSS routes into New Bedford and Buzzards Bay which are south and west of the New England Wind WDA, respectively. Depending on final layout, existing vessel traffic may transit within the turbines in the New England Wind WFA, or operators may avoid the New England Wind WFA and transit around it. However, we do not expect that this potential shift in traffic would increase the risk of interaction with listed species as we have not identified any areas where a theoretical risk of vessel strike would increase due to co-occurrence of vessels and whales, sea turtles, or Atlantic sturgeon being more likely such that risk of ship strike would increase. As such, even if there is a shift in vessel traffic outside of the WDA or any other change in traffic patterns due to the construction and operation of the project, any increase in risk of vessel strike is expected to be extremely unlikely to occur and therefore, effects are discountable.

7.2.4 Air Emissions Regulated by the OCS Air Permit
Park City has applied for OCS Air Permits from the EPA for Project 1 and Project 2. On December 19, 2023, the U.S. EPA issued draft OCS air permits for public comment. 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.

The "potential to emit" for the New England Wind Projects' OCS sources includes emissions from vessels installing the WTGs and the ESPs, engines on vessels that meet the definition of an OCS source, and engines (including any generators) on the WTGs and ESPs. 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 ESPs.

As described in the Fact Sheets prepared by EPA for the proposed permits, project impacts are compared to the national ambient air quality standards (NAAQS) and Prevention of significant deterioration (PSD) increments to demonstrate the project will not cause or contribute to a violation of these standards. EPA has evaluated the anticipated emissions during the construction and operations phases and made a preliminary determination that the emissions will be compliance with the relevant requirements. The NAAQS are health-based standards that the EPA sets to protect public health with an adequate margin of safety. . The PSD increments are designed to ensure that air quality in an area that meets the NAAQS does not significantly deteriorate from baseline levels.

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, project lighting during construction, and seabed disturbance from potential UXO detonations. Noise associated with these activities is discussed in section 7.1; associated vessel activities are discussed in section 7.2. Shortnose sturgeon are extremely unlikely to occur in the portion of the action area where these activities will take place; as such effects are extremely unlikely to occur and discountable.

7.3.1 Cable Installation

As described in section 3 above, a number of cables will be installed as part of the New England Wind project. Activities associated with cable installation include seabed preparation, cable laying, and activities to support the sea to shore transition at the landfall locations in Barnstable, Massachusetts, a Western Muskeget Variant for the OECC, a South Coast Variant including a landfall site and onshore substation in Bristol County, Massachusetts. Effects of these activities are described here.

New England Wind is proposing to lay the inter-array cable and offshore export cable using cable installation equipment that would include either a jet plow or 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 export cables, New England Wind is proposing to employ other methods of cable protection such as: (1) rock placement, (2) concrete mattresses, (3) rock bags, and (4) half-shell pipes (New England BA, 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. New England Wind anticipates up to 6 percent of the route is anticipated to require additional protection measures. 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. The BA does not describe any dredging associated with exit pits or other HDD activities, as such no dredging for this purpose is considered. Dredging of sand waves along portions of the OECC to support cable installation is addressed below.

7.3.1.1 Pre-lay Grapnel Run and Boulder Relocation

Prior to installation of the cables, a pre-lay grapnel run 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 or boulder plow. A displacement plow is a Y-shaped tool composed of a boulder board attached to a plow. The plow is pulled along the seabed and scrapes the seabed surface pushing boulders out of the cable corridor. Where appropriate, a boulder grab tool deployed from a DP vessel would also be used to relocate isolated or individual boulders.

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 and displacement plow will remain taut 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, a displacement plow, 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 adverse effects caused by this activity, including entanglement of any species during the cable laying operation, is extremely unlikely to occur, and are therefore, discountable. Effects of turbidity from cable laying are considered below.

7.3.1.3 Dredging to Facilitate Cable Installation

Following the pre-lay grapnel run, dredging within the OECC 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. New England Wind anticipates that dredging would occur on sand waves where bedform thickness exceeds 0.49 meters within 50 feet of the final centerline of the OECC corridor. Planned dredging methods anticipated for sand wave clearance include use of jetting techniques or mechanical plow (New England Wind BA, 2023). New England Wind anticipates sand wave leveling of approximately 314,800 m^3 (411,700 yd^3) of sediment over an approximately 119 acre area (New England Wind BA, 2023).

A controlled flow excavator (CFE) or hopper dredge may be used 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.

Hydraulic trailing suction hopper dredging involve the use of a suction to either remove sediment from the seabed or relocate sediment from a particular location on the seafloor. A hopper dredge may be used for sand wave clearance; effects are addressed below.

Effects of Hopper Dredge – Sand Wave Clearance

Hopper Dredge Interactions – Sea Turtles

Sea turtles have been known to become entrained in trailing suction hopper dredges, which can result in severe injury or mortality (Dickerson et al., 2004; USACE 2020). Animal interactions with a hopper dredge occur primarily from crushing when the draghead is placed on the bottom of the seabed or when an animal is unable to escape the suction of the dredge and becomes stuck on the draghead (impingement). Further, entrainment occurs when animals are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe, and then killed as they cycle through the centrifugal pump and into the hopper.

Interactions with the draghead can also occur if the suction is turned on while the draghead is in the water column (i.e., not seated on the bottom). For any dredging that occurs to support cable installation, procedures will be required to minimize the operation of suction when the draghead is not properly seated on the bottom sediments, which reduces the risk of these types of interactions.

The risk of interaction between suction hopper dredging and individual sea turtles is expected to be lower in the open ocean areas compared to nearshore navigational channels where sea turtles may be more concentrated and constrained (Michel et al., 2013; USACE 20202). Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the USACE

SAD, over 480 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 200 sea turtles have been killed since 1995. Records of sea turtle entrainment in the USACE NAD began in 1994. Through 2018, 88 sea turtles deaths (see Table 7.31) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE Sea Turtle Database[44]); 79 of these turtles have been entrained in dredges operating in Chesapeake Bay.

Interactions are likely to be most numerous in areas where sea turtles are resting or foraging on the bottom. When sea turtles are at the surface, or within the water column, they are not likely to interact with the dredge because there is little, if any, suction force in the water column. Sea turtles have been found resting in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Habitat in the action area is not consistent with areas where sea turtle brumation has been documented; therefore, we do not anticipate any sea turtle brumation in the action area.

As noted above, in the North Atlantic Division area, nearly all interactions with sea turtles have been recorded in nearshore bays and estuaries where sea turtles are known to concentrate for foraging (i.e., Chesapeake Bay and Delaware Bay). Very few interactions have been recorded at offshore dredge sites such as the ones considered in this Opinion. This may be because the area where the dredge is operating is more wide-open providing more opportunities for escape from the dredge as compared to a narrow river or harbor entrance. Sea turtles may also be less likely to be resting or foraging at the bottom while in open ocean areas, which would further reduce the potential for interactions.

Before 1994, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk district. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. Since 1992, the take of nine sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore, and New York Districts.

[44] The USACE Sea Turtle Data Warehouse is maintained by the USACE's Environmental Laboratory and contains information on USACE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

Table 7.3.1. Recorded Sea Turtle Takes in USACE NAD Dredging Operations

Project Location	Year of Operation	Cubic Yardage Removed	Observed Takes
Cape Henry Channel	2018	2,500,000	1 loggerhead
Thimble Shoals Channel	2016	1,098,514	1 loggerhead
York Spit Channel	2015	815,979	6 loggerheads
Cape Henry Channel	2014	2,165,425	3 loggerheads 1 Kemp's ridley
Sandbridge Shoal	2013	815,842	1 loggerhead[45]
Cape Henry Channel	2012	1,190,004	1 loggerhead
York Spit	2012	145,332	1 Loggerhead
Thimble Shoal Channel	2009	473,900	3 Loggerheads
York Spit	2007	608,000	1 Kemp's Ridley
Cape Henry	2006	447,238	3 Loggerheads
Thimble Shoal Channel	2006	300,000	1 loggerhead
Delaware Bay	2005	50,000	2 Loggerheads
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp's ridley 1 unknown
Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp's ridley 1 green
VA Beach Hurricane Protection Project (Cape Henry)	2002	1,407,814	1 Loggerhead
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp's ridley
VA Beach Hurricane Protection Project (Thimble Shoals)	2001	4,000,000	5 loggerheads 1 unknown
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
York River Entrance Channel	1998	672,536	6 loggerheads
Atlantic Coast of NJ	1997	1,000,000	1 Loggerhead

[45] Sea turtle observed in cage on beach (material pumped directly to beach from dredge).

Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware Bay	1995	218,151	1 Loggerhead
Cape Henry	1994	552,671	4 loggerheads 1 unknown
York Spit Channel	1994	61,299	4 loggerheads
Delaware Bay	1994	NA	1 Loggerhead
Cape May NJ	1993	NA	1 Loggerhead
Off Ocean City MD	1992	1,592,262	3 Loggerheads
			TOTAL = 88 Turtles

Typically, endangered species observers are required to observe at least 50% of the dredge activity (i.e., 6 hours on watch, 6 hours off watch). To address concerns that some loads would be unobserved, procedures have been in place since at least 2002 to insure that inflow cages were only inspected and cleaned by observers. This maximizes the potential that any entrained sea turtles were observed and reported.

It is possible that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, 2 Kemp's ridleys, and 1 leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, it is reasonable to conclude that the death of these sea turtles was attributable to dredging operations given the location of the strandings (e.g., in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (e.g., crushed or shattered carapaces and/or flipper bones, black mud in mouth). In 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located 3 miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. Because there were no observers on board the dredge, it is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils. Further analyses need to be conducted to better understand the link between crushed strandings and dredging activities, and if those strandings need to be factored into an incidental take level. Regardless, it is possible that dredges are taking animals that are not observed on the dredge, which may result in strandings on nearby beaches. However, there is not enough information at this time to determine the number of injuries or mortalities that are not detected.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

We are not aware of any hopper dredging that has occurred in the areas that may be dredged as part of the New England Wind project. The concentration of sea turtles in Chesapeake Bay is much higher than we anticipate for the areas to be dredged; therefore, using these projects to calculate an entrainment rate (i.e., sea turtles entrained per dredge volume) would result in a significant overestimate of the likelihood of interactions in the action area. We have calculated an entrainment rate by combining hopper dredge projects operating in Delaware Bay, in borrow areas on the Mid-Atlantic OCS, and mid-Atlantic navigation channels that have not used screening for unexploded ordinance (such screening decreases the ability of observers to detect entrained turtles) but have utilized endangered species observers for monitoring. These projects are combined in the table 7.3.2 below. Using these projects to calculate an entrainment rate is expected to result in a reasonable estimate of risk given the geographic similarity to the New England Wind dredge areas. The entrainment rate calculated for the projects listed in Table 7.3.1 indicates that entrainment of a sea turtle is likely to occur for every 3.8 million cubic yards of material removed with a hopper dredge (calculated by dividing the total cubic yards removed by the number of sea turtles entrained: 15,280,061 CY / 4 sea turtles = 3,820,015).

Table 7.3.2. Hopper dredging projects in the Mid-Atlantic without UXO screens and with endangered species observers.

Project Name	Year	CY Removed	Sea Turtle Interactions
Wallops Island, VA (OCS Borrow Area)	2013	1,000,000	0
Delaware Bay (Reach D)	2013	1,149,946	0
Wallops Island, VA (OCS Borrow Area)	2012	3,200,000	0
LBI Surf City	2006-2007	880,000	0
Delaware Bay - Channel Maintenance	2006	390,000	0
Delaware Bay - Channel Maintenance	2005	50,000	1

Delaware Bay - Channel Maintenance	2005	167,982	0
Delaware Bay	2005	162,682	0
Fenwick Island	2005	833,000	0
Cape May	2004	290,145	0
Delaware Bay - Channel Maintenance	2004	50,000	0
Cape May Meadows	2004	1,406,000	0
Cape May	2002	267,000	0
Delaware Bay - Channel Maintenance	2002	50,000	0 (bone)
Delaware Bay - Channel Maintenance	2001	50,000	0
Cape May City	1999	400,000	0
Delaware Bay - Channel Maintenance	1995	218,151	1
Bethany Beach and South Bethany Beach	1994	184,451	0
Delaware Bay - Channel Maintenance	1994	2,830,000	1
Dewey Beach	1994	624,869	0
Cape May	2005	300,000	0
Fenwick Island*	1998	141,100	0
Delaware Bay - Channel Maintenance (Brandywine)	1993	415,000	1
Bethany Beach*	1992	219,735	0
		15,280,061	**4**

Dredging (sand wave leveling) associated with the installation of the OECC will remove no more than 411,700 cubic yards of sediment. Considering the entrainment rate calculated above, we would predict entrainment of no more than 0.107 sea turtles during dredging (sand wave leveling) for the proposed OECC. Considering that only a portion of the proposed dredging would occur when sea turtles are present in the action area (i.e., dredging may occur at any time of year and sea turtles are only likely to be present June – November), that the dredging will occur outside of channels and bays where dredge interactions are more likely to occur, and that the interaction rate is largely based on dredge events in more southern waters where sea turtles are more numerous, the risk is even lower. Based on this, interactions between the dredge and sea turtles are extremely unlikely to occur and effects are discountable. No capture, impingement, or entrainment of any sea turtles is anticipated and no take is expected.

Hopper Dredge Interactions – Atlantic Sturgeon

Sturgeon are vulnerable to interactions with hopper dredges. The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (i.e., whether the fish are overwintering, foraging, resting or migrating) as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second. As noted above, exposure to the suction of the draghead intake is minimized by not turning on the suction until the draghead is properly seated on the bottom sediments and by maintaining contact between the draghead and the bottom.

A significant factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon such as the ones in the action area is less likely due to the increased swimming performance and the relatively small size of the draghead opening. Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically, major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not powerful swimmers and they are prone to bottom-holding behaviors, which make them vulnerable to entrainment when in close proximity to dragheads (Hoover et al., 2011). Juvenile sturgeon do not occur in the action area. The estimated minimum size for sturgeon that out-migrate from their natal river is greater than 50cm; therefore, that is the minimum size of sturgeon anticipated in the action area.

In general, entrainment of large mobile animals, such as the Atlantic sturgeon in the action area, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (e.g., in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead. Atlantic sturgeon are not anticipated to be foraging in the sediment in the areas to be dredged given that they are areas of dynamic sand waves that would not support benthic invertebrates that sturgeon would forage on. As such, sturgeon are not anticipated to be so close to the sediment to be vulnerable to entrainment in the hopper dredge. If Atlantic sturgeon are up off the bottom while in offshore areas, such as the action area, the potential for interactions with the dredge are further reduced. Based on this information, the likelihood of an interaction of an Atlantic sturgeon with a hopper dredge operating in the action area is expected to be low.

Nearly all recorded entrainment of sturgeon during hopper dredging operations has been during maintenance or deepening of navigation channels within rivers with spawning populations of Atlantic sturgeon. We have records of three Atlantic sturgeon entrainments outside of such river channels. Two of these are from York Spit Channel, Virginia and based on the state of decomposition of one of these it was not killed interacting with the dredge. The other record is from the Sandy Hook Channel in New Jersey. To calculate an entrainment rate for Atlantic sturgeon that would be a reasonable estimate for the action area, we have considered projects where hopper dredges operated without UXO screens and with endangered species observers and where we expect the observers would have reported any observations of sturgeon. We have limited the projects considered to those that are outside of rivers or other inland areas as the size class of sturgeon present in those areas would be different from the action area and we expect behavior of sturgeon to be different in those areas. As such, the level of entrainment in these areas would not be comparable to the level of interactions that may occur in the action area.

Table 7.3.3: Hopper Dredging Operations in areas within the USACE NAD similar to the action area (only projects that operated without UXO screens, and carried observers and complete records available are included)

Project Location	Year of Operation	Cubic Yards Removed	Observed Entrainment
Wallops Island offshore VA borrow area	2013	1,000,000	0
Wallops Island offshore VA borrow area	2012	3,200,000	0
York Spit Channel, VA	2011	1,630,713	1
Cape Henry Channel, VA	2011	2,472,000	0
York Spit Channel, VA	2009	372,533	0
Sandy Hook Channel, NJ	2008	23,500	1
York Spit Channel, VA	2007	608,000	0
Atlantic Ocean Channel, VA	2006	1,118,749	0
Thimble Shoal	2006	300,000	0

Channel, VA			
Cape May	2004	290,145	0
Thimble Shoal Channel, VA	2004	139,200	0
VA Beach Hurricane Protection Project	2004	844,968	0
Thimble Shoal Channel	2003	1,828,312	0
Cape May	2002	267,000	0
Cape Henry Channel, VA	2002	1,407,814	0
York Spit Channel, VA	2002	911,406	0
East Rockaway Inlet, NY	2002	140,000	0
Cape Henry Channel, VA	2001	1,641,140	0
Thimble Shoal Channel, VA	2000	831,761	0
Cape Henry Channel, VA	2000	759,986	0
Cape May City	1999	400,000	0
York Spit Channel, VA	1998	296,140	0
Cape Henry Channel, VA	1998	740,674	0
Thimble Shoal Channel, VA	1996	529,301	0
East Rockaway Inlet, NY	1996	2,685,000	0
Cape Henry Channel, VA	1995	485,885	0
East Rockaway Inlet, NY	1995	412,000	0
York Spit Channel, VA	1994	61,299	0
Cape Henry Channel , VA	1994	552,671	0
	TOTAL	25,950,197	2

In the absence of any dredging in the action area to base an entrainment estimate, we consider other projects that have been conducted in a comparable environment to that of the action area (see Table 7.3.3). As noted above, based on what we know about Atlantic sturgeon behavior in environments comparable to the action area, we consider the risk of entrainment at this site is similar to that of the projects identified in Table 7.3.3. At this time, this is the best available information on the potential for interactions with Atlantic sturgeon.

Using this method, and using the dataset presented in Table 7.3.3, we have calculated an interaction rate indicating that for every 12.98 million cubic yards of material removed, one Atlantic sturgeon is likely to be injured or killed. This calculation is based on a number of assumptions including the following: that Atlantic sturgeon are evenly distributed throughout the action area, that all hopper dredges will have the same entrainment rate, and that Atlantic sturgeon are equally likely to be encountered throughout the time period when dredging will occur. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of Atlantic sturgeon from past dredging operations, including dredging operations in the vicinity of the action area: it includes multiple projects over several years, and all of the projects have had observers present which we expect would have documented any entrainment of Atlantic sturgeon.

Dredging associated with the installation of the OECC will remove no more than 411,700 cubic yards of dredged material. Considering the entrainment rate calculated above, we would predict entrainment of no more than 0.032 Atlantic sturgeon during dredging for the proposed OECC installation. Considering that the dredging will occur outside of channels and bays where dredge interactions are more likely to occur, the risk is likely even lower. Based on this, interactions between the dredge and Atlantic sturgeon are extremely unlikely to occur and effects are discountable. No capture, impingement, or entrainment of any Atlantic sturgeon is anticipated and no take is expected.

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, is extremely unlikely to occur.

7.3.2 Turbidity from Cable Installation and Dredging Activities
Installation of the New England Wind export cable and inter-array cable would disrupt bottom habitat and suspend sediment in the water column. Potential types of equipment that may cause temporary increases in turbidity and sediment resuspension during cable installation include the use of a jet plow, mechanical plow, or a mechanical trench. As described in the BA, sediment dispersion modeling was conducted for New England Wind Farm Area (see COP, Section 4.3.2.2 and Appendix III-A for detailed descriptions; New England Wind BA 2023). Cable installation would produce the most extensive measurable suspended sediment impacts on the surrounding environment.

Cable installation would generate localized plumes of suspended sediments with TSS concentrations greater than 10 mg/L typically staying within 200 m (656 ft) of the alignment, though travelled a maximum distance of 2.1 km (6,890 ft) for typical installation parameters and up to 2.2 km (7,218 ft) for maximum impact parameters. Above-ambient TSS concentrations substantially dissipate within one to two hours and fully dissipate in less than four hours. Deposition greater than 1 mm was limited to within 100 m (328 ft) of the cable alignment for typical installation parameters and to within less than 150 m (492 ft) of the cable alignment for maximum impact installation parameters. During cable installation, the TSS plume is predicted to be located in the bottom 6 m (19.7 ft) of the water column. Modeling of sand wave dredging using a TSHD show above-ambient TSS concentrations of 10 mg/L extend up to 16 km (15,493 ft) and 8.5 km (27,887 ft) from the area of activity for TSHD and limited TSHD modeled scenarios, respectively. Concentrations of 10 mg/L persist less than six hours for TSHD activities and less than four hours for limited TSHD activities. Modeling results indicate that TSS concentrations greater than 100 mg/L do not persist in any given location outside of Nantucket Sound for longer than two hours (COP Appendix III-A). Deposition greater than 1 mm associated with TSHD is mainly constrained to within 150 m (492 ft) of the area of activity. Deposition related to overflow and dredged material release extends greater distances from the source, within 1 km (3,281 ft) but up to 2.3 km (7,546 ft) in when subject to the swift currents through the Muskeget Channel. Due to the hopper disposal, which release the entire hopper of sediment in one location, deposition can be up to 100 mm (0.33 ft) in these locations.

All sediment impacts from dredging and cable installation would be localized around the source of disturbance and intermittent in association with the duration of bed-disturbing activities.

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 and thus discountable. If 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 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 7.3.1.4.

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.

Any Atlantic sturgeon within 25 m (82 ft) of the cable laying operations for the inter-array cable would be exposed to TSS greater than 100 mg/L. TSS plumes >100 mg/L could persist up to one hour but do not persist for any activity for longer than two hours (COP Appendix III-A). Atlantic sturgeon within 42 m (138 ft) of the cable laying operations for the New England Wind export cable would be exposed to TSS at 50 to 100 mg/L. Elevated TSS levels associated with New England Wind export cable installation are not expected to persist for more than four hours.

Appendix III-A of the COP (New England Wind 2023) concluded that TSS concentrations are predicted to return to ambient levels (less than 10 milligrams per liter) within one to two hours following completion of IAC installation. The TSS plume is predicted to be contained within the lower portion of the water column, approximately 6 m (19.7 ft) above the seafloor. Given that both the modeled and observed TSS effects would be short term and within the range of baseline variability. 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, any effects to Atlantic sturgeon are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and therefore, effects are insignificant. Effects to Atlantic sturgeon prey are addressed below.

7.3.3 Impacts of Cable Installation Activities on Prey

Here we consider the potential effects of 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 finmarchicu*s, 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.

Blue whales
Blue whales feed exclusively on krill. Given the rarity of blue whales in the area where project activities will occur, it is extremely unlikely that any blue whales would be foraging in the area where increased turbidity would occur and extremely unlikely that any potential blue 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 New England Wind 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 of Cable Installation Activities on the Prey Base of ESA-listed Species in the Action Area

Dredging
Dredging will result in a temporary loss of benthic prey in the areas being dredged. We have considered the potential effects on sea turtles and Atlantic sturgeon that may forage opportunistically along the sand waves where dredging will occur. Given the dynamic nature of sand waves the area is subject to frequent shifting sediments.

Given that the areas impacted are small and will be dispersed along the cable route and that recolonization is expected, any losses of benthic resources will be small and temporary.

Therefore, 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.

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 three hours); elevated TSS is limited to the bottom 3 meters 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. 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; any effects to these listed species as a result of effects to prey will be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore insignificant.

Benthic Invertebrates
In the BA, BOEM indicates that an area approximately 50-feet wide along the cable corridor and 5-feet at the splice vaults will be disturbed during cable installation; this is likely to result in the

mortality of some benthic invertebrates in the path of the jet plow. 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 corridor 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 3 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.

SAV/Eelgrass (Zostera marina)
A pre-construction and installation SAV survey will be completed and construction/installation of cofferdams and cables will be carried out in a manner that avoids impacts to SAV to the greatest extent practicable. In general, SAV provides important nursery and foraging habitat for ESA-listed sea turtles. Sea turtle occurrence in Nantucket Sound, where any impacts from the sea to shore transition would be experienced, is rare. Given the small area of SAV impacted and the limited use of these areas by sea turtles, effects to sea turtle prey and foraging habitat will be too small to meaningfully measure, detect, or evaluate, and therefore, are insignificant.

Water Withdrawal for Jet Trenching
As described in the COP (Section 4.3.3.2), fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained during jet trencher embedment of the IAC. Jet trencher equipment uses seawater to circulate through hydraulic motors and jets during installation. Although this seawater is released back into the ocean, survival rates of entrained eggs, larvae, and zooplankton are unknown and it is possible that all entrained organisms will be killed. Only early life stages may be affected by jet plow entrainment; later life stages will not

be affected. These will be one-time losses and will occur over a short period. A previous assessment conducted for the South Fork Wind Farm found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the project area, which encompassed a linearly buffered region of 15 km around the export cable and 25 km around the wind farm (INSPIRE Environmental, 2018b). We would expect similar impacts from the New England Wind cable installation. Given the extremely small, localized, and one-time losses of ichthyoplankton, we expect any effects to the forage base for ESA listed species would be equally small, localized, and temporary. As such, effects to ESA listed species are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore, insignificant.

7.3.4 Turbidity during WTG and ESP Foundation Installation

WTG and ESP foundation installation as well as the deposition of rock for 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. 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. It is anticipated 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, in assessments of other suction bucket foundation installations (e.g., BA for the Atlantic Shores South Project), 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 would 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, New England Wind 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 is 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.

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 650 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings.

7.3.7 Unexploded Ordnance (UXO) Detonation - Seabed Disturbance and Turbidity

The proposed action includes the detonation of up to 10 UXOs. Therefore, we are assessing the potential effects to the seabed from potential UXO blasting/detonation. In section 7.1, effects to whales, sea turtles, and Atlantic sturgeon from exposure to UXO/MEC detonations were addressed.

There is very limited information about seabed disturbances following the blasting/detonation of UXOs. Generally, it can be assumed that the detonation of a UXO may leave a crater or scar in the seabed following blasting. The total seabed area disturbed is expected to be related to the size of the UXO, the existing seabed conditions, and the UXO detonation method. New England Wind proposes to first avoid interaction with any existing UXOs. If avoidance cannot be achieved, physical relocation through a “Lift and Shift” strategy where a UXO is moved to another suitable location would be next. In situations where UXOs cannot be avoided or physically relocated, a low-order (deflagration) method would be considered. Deflagration, a low-order detonation method, consists of a shape charge with insufficient shock to detonate, and with the explosive material inside the UXO reaching with a rapid burning rather than a chain reaction that would lead to a full explosion (ESTCP 2002, Robinson *et al*. 2020, Lepper, pers. comm. 2022). Deflagration would have little to no impact on the seabed as there is not a full explosion, thus we would not expect much disturbance of the surrounding substrate. A high-order detonation is conducted by exploding a donor charge placed adjacent to the UXO munition (Albright 2012, Aker et al. 2012, Sayle et al. 2009, Cooper and Cooke 2018, Robinson et al. 2020). In the event of a high-order UXO detonation, it is likely that the seabed around the location of the UXO will be disturbed. Given the sandy substrate in areas where UXO could be detonated and the dynamic benthic environment, we expect any craters or scars to fill in naturally over time. We do not expect any effects to listed species from these impacts. Additionally, while there could be increases in turbidity as sediment is disturbed during a detonation, any sediment would quickly settle out of the water column; effects to listed species from a localized, temporary increase in suspended sediment are expected to be so small that they cannot be meaningfully measured, evaluated, or detected, and are therefore insignificant.

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). Phase 1 of the proposed Project would consist of two 220-275 kV high voltage alternating current (HVAC) offshore export cables, and Phase 2 would consist of either two or three 220-345 kV HVAC offshore export cables or one bundled 320-500 kV high voltage direct current (HVDC) offshore export cable.

To minimize EMF generated by cables, all cabling would be contained in electrical shielding (i.e., grounded metallic sheaths and steel armoring) to prevent detectable direct electric fields. New England Wind would also bury cables to a target burial depth of approximately 5 – 8 ft. (1.5 – 2.5 m) 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 New England Wind (i.e., up to 500 kV). 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). In the BA, BOEM reports that EMF measurements of the Block Island Wind Farm cables showed a maximum reading of 8 mG, which was lower than the modeled EMF level of 22 mG (Shuman 2017 as cited in BOEM's BA).

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 New England Wind Farm inter-array cable and New England Wind export cable, 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. Therefore, effects are extremely unlikely to occur and are discountable.

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). As noted in the BA, modeling was not carried out for the New England Wind cables. However, modeling carried out for the nearby planned Revolution Wind Farm, with similar cables is available. Modeling for the Revolution Wind Farm cables (Exponent Engineering, P.C. (2021)) calculated that the maximum induced electrical field strength inter-array cables and export cables would be 0.7 mV/m or less, which is above the detection threshold for this species. Additionally, 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 will 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.

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 New England Wind 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 New England Wind 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; therefore, effects are 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 New England Wind 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 (1 m) 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 New England Wind Farm inter-array cable and New England Wind export cables are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, insignificant.

Effects to 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 cables is detectable. We have considered whether magnetic fields associated with the operation of the cables could impact benthic organisms that serve as sturgeon and sea turtle prey. A number of studies on the effects of exposure of benthic resources to magnetic fields are available. 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.

7.4.2 Lighting and Marking of Structures

To comply with FAA and USCG regulations, the WTGs and ESPs 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 ESPs. 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.

New England Wind Farm construction and installation vessels would introduce stationary and mobile artificial light sources to the marine component of the action area. Construction and installation and O&M lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations. New England Wing Farm will also use Aircraft Detection Lighting System (ALDS) (or similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. Each WTG will be marked and lit with both USCG and approved aviation lighting. 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 690 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings in known nesting beaches. While we recognize that rare nesting events have been recorded in New York and New Jersey, these remain unexpected events that require human intervention (i.e., nest relocation) to produce successful hatchlings and this does not change our conclusions regarding the impacts of project lighting.

7.4.3 WTG and ESP 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 New England Wind 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. Construction for the South Fork and Vineyard Wind 1 projects is currently underway, with a limited number of turbines operational at this time. 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 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 ESPs 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 (12 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 32.6 m. Based on the spacing of the foundations (1 x 1 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 smaller number of foundations to the New England Wind project (80 foundations in Hons Rev and 130 in New England Wind) 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 occur in low densities 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 ESP 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 be a maximum of 9.8 feet (3 meters) in height from the seabed level and would have an area of 1.2 acres per monopile.

The footprint of 130 WTG and ESP foundations and associated scour protection in the form of boulders and concrete mats would permanently modify approximately 258 acres of seabed. In addition, approximately 31 acres of the seabed would be permanently modified in order to protect inter-array, export, and interconnection cables. In total, permanent habitat disturbance of 289 acres is anticipated to result from the project. The addition of the WTGs and ESPs, spaced 1.0 nautical mile apart, is expected to result in a habitat shift in the area immediately surrounding each monopile from soft sediment, open water habitat system to a structure-oriented system, including an increase in fouling organisms. Overall, construction of the New England Wind foundations, cables, and associated scour protection would transform 360.7 acres (0.49 km^2) of soft bottom habitat into coarse, hard bottom habitat. For context, lease area OCS-A 0534 is approximately 101,590 – 111,939 acres depending on the final footprint of the Vineyard Wind Project. 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 constructed 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 New England Wind 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, just over 0.3% (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 0.3% reduction in availability of sand lance in the lease area and a 0.0001% 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. 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. 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.

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 (0.3% 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. 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 New England Wind WFA is located within multiple defined marine areas. Here, we consider the best available information on how the presence and operation of the up to 132 foundations with up to 129 WTGs and 2 to 5 ESPs proposed for the New England Wind 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 that help inform the potential effects offshore wind facilities may have on the oceanic and atmospheric environment; summaries of several of these studies, which represent the best available science on operational effects to oceanic and atmospheric conditions, 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 a wind facility) and were carried out in Europe, specifically the North Sea, where commercial-scale offshore wind facilities are already in operation. At various scales, documented effects include increased turbulence, changes in sedimentation, decreased dissolved oxygen, 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 (HDR 2020); however, no additional reports or literature about oceanographic or atmospheric impacts during operation has been published. 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 nearby the New England Wind WFA, began in the summer of 2023 and is ongoing; as neither of these projects are fully 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
At the broadest scale, the proposed New England Wind project is located within the Southern New England sub-region of the U.S. Northeast Shelf Large Marine Ecosystem, and the northern end of the Mid-Atlantic Bight (Kaplan 2011). The region is a dynamic area between southward flowing cool arctic waters and northward flowing warm tropical waters, with complex seasonal physical dynamics, which support a diverse marine ecosystem. The physical oceanography of this region is influenced by local bathymetry, freshwater input from multiple rivers and estuaries, large-scale atmospheric patterns, and tropical and winter coastal storm events. Weather-driven surface currents, fronts, upwelling, tidal mixing, and estuarine outflow all contribute to driving water movement both at local and regional scales (Kaplan 2011). These dynamic regional ocean properties support a diverse and productive ecosystem that undergoes variability across multiple time scales.

A variety of 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 such as temperature, chlorophyll, and salinity at a range of depths. Additionally, long-term shelf-wide surveys provide data used to estimate spawning stock biomass, overall fish biodiversity, zooplankton abundance, information on the timing and location of spawning events, marine mammal and sea turtle abundance, and insight to detect changes in the environment.

In the waters of the New England Wind WFA and surrounding areas along the continental shelf, the broad, year-round pattern of currents are generally understood. Water flows south along the western margins of the Gulf of Maine due to a cyclonic gyre before splitting near the northern portion of the Great South Channel (east of Cape Cod), with one branch flowing northeast along the northern edge of Georges Bank, and the other flowing west either over or around the outer edge of Nantucket Shoals, continuing westward along the continental shelf of southern New England towards the Mid-Atlantic Bight. This westward non-tidal circulation flow is constant with little variability between seasons (Bigelow 1927, Pettigrew et al. 2005, Kraus, Kenney and Thomas 2019). The Nantucket Shoals region is characterized by tidal front activity that overlaps with right whale distribution and serves to aggregate prey for a variety of higher trophic species (Ullman and Cornillon 2001, White and Viet 2020, Quintana-Rizzo et al. 2021).

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 New England Wind 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 et 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). In the southern New England region, a northeastward propagating tidal wave interacts with the unique topography of Nantucket Shoals to cause upwelling, convergence, and a rotary current around Nantucket Shoals (White and Viet 2020).

The cold pool supports prey for a number of 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 are mobile, 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. ESA listed species in the southern New England region (the larger region that includes both the RI/MA WEA and MA WEA) primarily feed on five prey resources - zooplankton, pelagic fish, gelatinous organisms/cephalopods, marine vegetation, and benthic invertebrates. Of the listed species in the area, North Atlantic right whales are the only obligate zooplanktivores. Blue whales, which occur primarily along the shelf break rather than on the shelf where the New England WFA is located, feed primarily on krill but also feed on fish and zooplankton. ESA-listed large whales and sea turtles have been observed foraging in both the RI/MA and MA WEAs, including the area where the proposed New England Wind project will be constructed (Leiter et al. 2017).

High densities of North Atlantic right whales and leatherback sea turtles are often observed around Nantucket Shoals, a bathymetric feature to the east of the New England Wind WFA (Dodge et al. 2014, Kraus et al. 2016, Leiter et al. 2017, Stone et al. 2017, and Quintana-Rizzo et al. 2021). Nantucket Shoals supports frontal zones that aggregate prey (White and Viet 2020). The influence of this bathymetric feature on prey is particularly relevant to North Atlantic right whales and leatherback sea turtles as their prey is planktonic (copepods. and gelatinous organisms, respectively). As described above, physical and oceanographic features are the primary drivers that control aggregations and concentrations of plankton. The distribution of *Calanus* sp. (the primary forage of right whales) is largely driven by season, water movement, and their daily vertical migration (Baumgartner et al. 2007). Other listed species, which eat forage fish, cephalopods, crustaceans, and marine vegetation, are not as closely tied to physical oceanographic features that concentrate prey, given those species' prey are either more stationary on the seafloor or are more able to move independent of typical ocean currents. However, while forage fish species do move independent of ocean currents, many of these species prey on plankton.

Since around 2010, North Atlantic right whales have been sighted more frequently in southern New England waters than in previous time periods (Meyer-Gutbrod et al. 2022, O'Brien et al. 2022). The southern New England region is generally defined as the area south of Martha's Vineyard and Nantucket to the shelf edge and bounded to the east by Nantucket Shoals and Block Island to the west. There is a seasonal dynamic to right whale habitat use in this area, with some inter-annual variability. Right whales predominantly occupy Nantucket Shoals and the western and southern edges of the Shoals during the fall (September – November), remain in this general area in the highest densities during the winter (December – February) and then shift their distribution to areas across portions of the RI/MA and MA WEAs and waters immediately south throughout the spring (March – May). In the spring, right whales have been sighted in and immediately adjacent to the New England Wind WFA (Stone et al. 2017, Quintana-Rizzo et al. 2021). Summer (June – August) is when right whale density is lowest in the southern New England region generally, and in the New England Wind WFA specifically. However, right whales have been both sighted and detected year-round throughout the entire southern New England region (Estabrook et al. 2022, O'Brien et al. 2022, Van Parijs et al. 2023). North Atlantic right whales use the southern New England region for migration as well as feeding and socializing; observations of both feeding behavior and surface active groups have been observed throughout the year (Kraus et al. 2016, Leiter et al. 2017, Stone et al. 2017, Quintana-Rizzo et al. 2021, Estabrook et al. 2022, O'Brien et al. 2022). In more recent years, right whales have been observed on Nantucket Shoals starting in August with whales present throughout the southern New England region through the spring. Mean residency time of individual right whales in this area is estimated to be 1-2 weeks (Quintana-Rizzo et al. 2021). Both the estimated abundance of right whales and unique individuals per unit of survey effort increased from 2013-2019 (O'Brien et al. 2022). It is important to note that the Nantucket Shoals area does not overlap with the New England Wind WFA; the WFA is farther west. A species distribution model that incorporated the primary prey (*Calanus finmarchicus*) of North Atlantic right whales and environmental covariates predicted areas of high foraging habitat suitability in southern New England (Pendelton et al. 2012), and a separate density model (Roberts et al. 2023) for right whales also predicted areas of high density for right whales in southern New England waters and seasonally in the New England Wind WFA.

High use areas for North Atlantic right whales (also referred to in some literature as "hotspots," which are often defined as season−period combinations with greater than 10 right whale sightings and clusters within a 90% confidence level) are primarily nearby, but outside, the footprint of the New England Wind WFA. The exception is that during March - May, these high use areas overlap portions of the northeastern part of the New England Wind WFA (Quintana-Rizzo et al. 2021). During spring (March-May) in 2011- 2015 and 2017-2019, the northeastern, northwestern, and northern portions of the New England Wind WFA, respectively, and adjacent waters to the north, east, and west were high use areas for right whales, with both feeding and social behavior (social active groups) observed (Leiter et al. 2017, Quintana-Rizzo et al. 2021). Conclusions about feeding behavior were based on sightings of right whales open-mouthed or just below the surface as sub-surface feeding at depth could not be confirmed. Passive acoustic detections have confirmed seasonal right whale presence in and around the New England Wind WFA throughout the year (Estabrook et al. 2022, Van Parijs et al. 2023).

As mentioned above, currents flow into southern New England waters from the Gulf of Maine; these currents are thought to transport *Calanus* sp. into the area (Johnson et al. 2006, Ji et al. 2009, Bi et al. 2015). Oceanographic and physical features in the southern New England region can then act to concentrate *Calanus* sp. and other copepods. Little is confirmed about the specific oceanographic processes driving right whale feeding habitat in the southern New England region, but right whale distribution is likely linked to the distribution and availability of planktonic prey distributed and aggregated by currents and oceanographic conditions (Pendleton et al. 2009). Similarly, the distribution of leatherback sea turtles is linked to planktonic prey resources (Dodge et al. 2014). Sei and fin whales are often observed during the spring and summer throughout the RI/MA WEA and MA WEA, with feeding behavior observed during both periods (Kraus et al. 2016, Stone et al. 2017), however both species eat small schooling fish as well as plankton and cephalopods and their distribution is not as well associated with oceanographic features that concentrate zooplankton.

Summary of Available Information on the Effects of Offshore Wind Facilities on Environmental Conditions

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 turbines 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 were reported. The authors note that these impacts were limited to the vicinity of the modeled wind facility. 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 New England Wind 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 facilities equipped with 10 and 15 MW offshore wind turbines. In the model, they simulated 30 GW of offshore wind turbines located in identified lease and planning areas off the U.S. Atlantic coast. 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 facilities 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 New England Wind 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 on the abundance or distribution of ESA-listed species or the abundance or distribution of their 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 MW 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 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; their study describes wind wakes that extend up to or greater than 62 miles (100 km) downstream of large offshore wind facilities.

Models have predicted reductions in surface winds and wind stress 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 offshore wind projects (~ 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 facility, 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 facility, 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 10 km of the turbine.

Ocean-Atmosphere Responses to Wind Field Interactions

The disturbance of wind speed and wind wakes from wind facilities 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), an offshore wind facility 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, and 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 facility 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 km). Second, the thermocline exhibited diagonal excursions, with maximum vertical displacement of 46 ft. (14 m) over a dipole dimension of 6–7 miles (10–12 km). Additionally, 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 km 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 an offshore wind facility under certain conditions (Forster 2018). Johnson et al. (2021) 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 southern New England lease areas. Results of the hydrodynamic modeling suggested that the extraction of wind energy by offshore wind facilities in the southern New England lease areas 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 ft. (0.75 m) inside the facility, by up to 1.48 ft. (0.45 m) just outside the facility, and up to 0.49 ft. (0.15 m) 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). Offshore wind facilities may 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-mm 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 mm), 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 MA-RI WEA. 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 ft. (1 to 2 m) 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, with more cold water retained within the footprint of the offshore wind facility (Johnson et al. 2021). 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. Also, the wind turbine wake loss model and corresponding wind speed and sea surface wind stress reduction were only confined to the domain of the model that were inside the offshore wind development area which limits the application of the results outside of that area.

Using remote sensing, Vanhellemont and Ruddick (2014) showed that offshore wind facilities 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 kilometers 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 facilities 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 wind facilities (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 wind facilities 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 or more) of the North Sea would need to be covered with wind turbines; 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 the foundations, 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 turbulence remained within the first 100 m from the turbine foundation under a range of stratified conditions. Field measurements at the offshore wind facility 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 foundations at DanTysk are 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 affected oceanic regions; however, the scale and degree of those effects is dependent in part on location. If wind projects are constructed in areas of tidal fronts, the physical structure of wind turbine foundations (i.e., the foundation structure itself) may alter the structure of fronts, which could affect distribution of prey and lead to effects to the marine vertebrates that use these oceanic fronts 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 relation to the role of tides in wake-induced hydrodynamic perturbations, Christiansen et al. found that tide-related hydrodynamic features (e.g., currents and fronts) influence the development of wake effects in the coastal ocean. Tidal current were found to be able to counter changes in horizontal surface currents and in shallower waters, tidal stirring influences how wake effects translate to changes in vertical transport and density stratification (Christiansen et al. 2022). 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 facility in the North Sea. Vertical mixing was found to be increased within the footprint of the wind facility, leading to a doming of the thermocline and a subsequent transport of nutrients into the surface mixed layer. Though discerning a wind facility-induced relationship from natural variability is difficult, wind facilities 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 form, potentially resulting in more retention of plankton in the region when combined with 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 are yet to be observed in southern New England.

Van Berkel et al (2020) investigated available information on the effects of offshore wind facilities on hydrodynamics and implications for fish. The authors report that changes in the demersal community have been observed close to wind facilities (within 50 m) and that those changes are related to structure-based communities at the foundations (e.g., mussels). The authors also report on long-term studies of fish species at the Horns Rev 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 offshore wind energy facilities or inside/between the foundations at wind facilities. 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 (Cazenave et al. 2016). 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.

The National Academies of Sciences, Engineering, and Medicine recently released a report "Potential Hydrodynamic Impacts of Offshore Wind Energy on Nantucket Shoals Regional Ecology: An Evaluation from Wind to Whales" which considered the potential for offshore wind facilities in the Nantucket Shoals region to affect oceanic physical processes and how hydrodynamic alterations may affect the local to regional ecosystem, particularly North Atlantic right whale foraging and prey resources (NASEM 2023). The findings in the report acknowledge that offshore wind energy development may impact oceanic physical processes that influence right whales through the abundance and distribution of their prey, but acknowledge significant uncertainty in the potential impacts from offshore wind development, and therefore provided a number of recommendations for additional observational research and modeling studies (NASEM 2023). The report noted that the magnitude of potential effects from offshore wind development may be less than from ongoing climate induced changes. We note that this does not necessarily mean that impacts from offshore wind development will be non-significant or not detectable and that they may be incremental as additional development occurs. We also acknowledge that changes to the southern New England ecosystem that may result from offshore wind development may be difficult to discern from those attributable to climate change particularly absent a robust monitoring strategy.

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 foundations 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. The potential for increased mixing may also increase nutrients and therefore increase phytoplankton growth. 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 facility 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 effects on phytoplankton and zooplankton might extend to upper trophic level impacts, potentially modifying the distribution and abundance of finfish and invertebrates. The spatial scale of these effects remains unknown but could range from localized within individual facilities 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 facility in China. The facility 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 offshore wind facility, 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 microzooplankton). However, given that there are significant differences in the location and conditions between the site in China and the New England Wind WFA (e.g., tidal flat/intertidal zone vs. 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 New England 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 offshore wind facility 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 offshore wind facility clusters in the inner German Bight and at Dogger Bank, which are both situated in highly productive frontal areas, and a netPP 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 an offshore wind facility 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 New England Wind Project
The predominant wind direction in the New England Wind WFA is from the west, northwest, and southwest with some variability from eastern directions depending on time of year (New England Wind COP, Volume II, 2021). Average wind speed is 8.6 meters/second (m/s), with stronger winds observed during winter (New England Wind COP, Volume II, 2021). The predominant flow of ocean surface currents is bimodal, indicating an east/west tidal influence; the current direction modes are 98˚/278˚. Currents show some variability due to season, tides, winds, and bathymetry. Mean current speed varies with depth, highest mean speed of 0.19 m/s was recorded at 21 m depth, bottom currents are weaker during normal conditions, with average speeds less than 0.1 m/s (New England Wind COP, Volume II, 2021).

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 presence and operation. These impacts include increased turbulence generated by the presence of turbine foundations, extraction of wind/kinetic energy 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 facilities. However, discerning a wind facility-induced relationship from natural variability and climatic changes is difficult and very specific to local environmental conditions where the offshore wind project 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 facility size and orientation (Miles et al. 2021).

Here, we consider the *Environmental Baseline*, the information presented above regarding available studies, incorporate the layout and parameters of the New England Wind project and local oceanographic and atmospheric conditions, and evaluate anticipated effects to ESA listed species. We note that while we are using the best available information to assess effects of the New England Wind project, given the lack of site specific data, there is uncertainty about how offshore wind projects in the action area may alter oceanographic processes and the biological systems that rely on them. However, based on observed and modeled results described in the summary of the best available information above, we do expect effects to occur, but acknowledge there is uncertainty regarding the scale/magnitude and extent of these effects in the context of the southern New England ecosystem and the New England Wind project specifically. The best 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 New England Wind project (up to 129 WTGs [maximum hub height of 214 m above mean lower low water] and their foundations and two to five ESPs) and its specific geographic location in consideration of the Environmental Baseline, which takes into consideration the presence and operation of the Vineyard Wind 1, South Fork, Revolution Wind, Sunrise Wind, Empire Wind, Atlantic Shores-South, and Ocean Wind 1 projects, which are all located within the New England Wind action area. The analysis and conclusions reached here may not be reflective of the consequences of larger scale offshore wind development in the region or even a single project in a different location.

As explained above, based on the available information, we do not find any evidence that installation of up to 132 foundations and operation of WTGs and ESPs for the New England Wind project would lead to ocean warming that could affect ESA listed whales, sea turtles or fish or that there is the potential for the New England Wind project to contribute to or exacerbate warming ocean conditions; if anything, the project may result in minor, localized cooling.

When applying studies conducted outside southern New England and the greater Mid-Atlantic Bight region to our consideration of the potential effects of the New England Wind 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 in southern New England and the greater Mid-Atlantic Bight region (Castelao, Glenn, and Schofield, 2010). The conditions in the North Sea are more representative of weaker stratification, similar to conditions seen in southern New England and the Mid-Atlantic Bight during the spring or fall (van Leeuwen et al. 2015). 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 and potential for increased turbulence during this period when waters are more unstable than during highly stratified conditions in the summer (Kohut and Brodie 2019, Miles et al. 2021).

Offshore wind energy development is likely to alter the atmospheric and the physical and biological oceanographic environments due to the influence of the energy extraction on the wind stress at the ocean surface; further, 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 strong stratification such as the cold pool, large regions would need to be covered by wind turbines. Given the scale of the New England Wind project (132 foundations), any effects of stratification are not expected to reach the scale that would affect the timing and rate of breakdown of the cold pool in the fall. Also, at this time, the available information does not suggest that the effects of the New England Wind project in addition to the other permitted offshore wind projects in the action area, would be sufficiently great to affect the timing and rate of breakdown of the cold pool.

Based on the available information, it is likely that the New England Wind project will produce a 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 on a scale of hundreds of meters and up to 1 km from each foundation (Floeter et al. 2017, van Berkel et al. 2020). Documented changes in mixed layer depth and thermocline conditions have been observed extending up to 12 km between the paired upwelling peak and downwelling patterns (dipole) at one wind facility with the upwelling and downwelling extending approximately 20 km from the wind facility (Floeter et al. 2022). Similar effects on mixed layer depth and thermocline conditions may occur in the lee of the New England WFA when the wind and current direction is consistent. These changes in conditions may alter the distribution of nutrients, primary production, and plankton. Alterations to wind fields and the ocean–atmosphere interface have also been modeled as modifying both atmospheric and oceanographic patterns on large spatial scales of up to tens of kilometers (Gill et al. 2020, Christiansen et al. 2022). As noted above, oceanic response to an altered wind field is predicted to extend greater than 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).

Due to the linkages between oceanography and food webs, lower-trophic level prey species that support listed species may be affected by changes in stratification and vertical mixing. There is limited information on which to base an assessment of the degree that the proposed project will result in any such impacts. No utility scale offshore wind facilities are in operation in the offshore waters of the United States; therefore, there are no projects in coastal waters of the United States that can be used to evaluate potential impacts of the proposed New England Wind project. The Vineyard Wind 1 and South Fork projects, which are both under construction, have a small number of operating turbines, but as a whole neither wind facility is operational and we are not aware of any available information on effects of their operation on the conditions addressed here. Thus we only have results from modeling and 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 ESA listed species and their prey.

Results of in-situ research, and modeling and simulation studies, show that offshore wind facilities can reduce wind speed and wind stress which can lead to less mixing, lower current speeds, and variations in 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, Floeter 2022); and result in detectable sediment wakes downstream through increased turbidity (Vanhellemont and Ruddick, 2014). We have considered if these impacts could result in disruption of prey aggregations, primarily of planktonic organisms transported by currents such as copepods and gelatinous organisms (e.g., salps, ctenophores, and jellyfish medusa).

This possible effect is primarily relevant to North Atlantic right whales and leatherback sea turtles as these are the only listed species that occur in the New England Wind WDA that feed solely on planktonic prey (primarily calanoid copepods and gelatinous organisms respectively) whose aggregations are primarily driven by hydrodynamic processes. As described in Section 5 and 6, right whale foraging areas have shifted since 2010. This foraging shift is likely at least partially due to changing ocean conditions that are attributable to climate change, resulting in changes in copepod abundance and distribution (Meyer-Gutbrod et al. 2023). This, in combination with other stressors, has impacted the health and reproductive status of individual right whales such that the population is considered to be vulnerable to disruptions of foraging and prey resources (Runge et al. 2023). As aggregations of zooplankton, which provide a dense food source for North Atlantic right whales to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities for North Atlantic right whales. Increased mixing may also increase the nutrient supply to the upper water column and in turn cause phytoplankton blooms, thus creating a food source for zooplankton. 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 that 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.

Based on the best available information as cited herein, we do not expect the scope of oceanographic, atmospheric, or hydrodynamic effects from the proposed New England Wind project to be large enough to influence regional conditions that could affect the distribution of prey, mainly plankton, or conditions that aggregate prey in the broader Mid-Atlantic Bight region or within or around the MA/RI WEA in a way that would have adverse effects on ESA listed species that are reasonably certain to occur. Given that right whale foraging appears to occur both within the New England Wind WFA (Leiter et al. 2017, Quintana-Rizzo et al. 2021) and in the lee of the WFA (east/northeast, based on predominant wind direction), we expect individual turbine/near-field effects to be the primary drivers of changes in zooplankton distribution with potential effects occurring due to far-field effects from energy extraction in the lee of the WFA. We expect localized impacts to oceanic conditions to extend tens of kilometers from the outermost row of foundations in the New England Wind lease area that would vary directionally based on the direction of the wind and flow of water (Gill et al. 2020, Christiansen et al. 2022, Floeter et al. 2022). However, based on the available information presented above and the location of the New England Wind WFA relative to the predominant westward flow of water in the southern New England region during the time of year when right whales are more likely to be present and foraging, we do not expect the impacts to oceanic conditions resulting from the New England Wind project to affect the oceanographic forces transporting plankton into the area from the south and east; however, there may be effects on the distribution of plankton more locally. Based on the currently available information, we are not able to determine that any local disruptions would result in adverse effects to foraging right whales. Some copepod species are resident in southern New England and thus may not be advected into the region, however the best available information indicates that the dominant flow bringing some zooplankton species to the region - particularly the copepod *C. finmarchicus,* a primary food source for right whales - originate from the Gulf of Maine and wrap around Nantucket Shoals following bathymetric contours towards the New England Wind WDA (Johnson et al. 2006, Ji et al. 2009, Bi et al. 2015). We do not expect the construction and operation of the New England Wind project to alter this broad current pattern, and thus expect any alteration of the biomass of plankton in the region, and therefore, the total food supply, to be so small that adverse effects on ESA listed species are not reasonably certain to occur.

Although uncertainty remains as to the magnitude and intensity of effects that offshore wind facilities may have on altering oceanographic processes, studies demonstrate increased turbulence is expected to occur in the wake of foundations. These turbulence wakes have been detected up to 300 m from turbine foundations (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 New England Wind project that would be a distance of 104 to 130 m from the 13-m diameter monopiles which are the largest foundation size considered for the project, we note this distance may be shorter (and an area of weaker disturbance) from any jacket foundation or bottom-frame foundation (jacket and bottom-frame foundations use multiple 4-m diameter pin piles to secure the foundation to the seafloor) as the diameter of piles are smaller and the jacket and bottom-frame is a more open structure that allows water to flow through the structure. We expect that any effects on the distribution or density of zooplankton prey due to turbulence from the foundations would be limited to the area where changes in turbulence would be experienced. These anticipated localized changes down-current of the foundations of the wind turbines could result in localized changes in plankton distribution and abundance within discrete areas of the New England Wind WFA extending up to 300 m down-current from each foundation (Floeter et al. 2017). The wind facilities measured in Floeter et al. employed tripod/tri-pile foundations, which are similar to the jacket and bottom-frame foundations proposed for New England Wind, however, monopile foundations are also proposed. Due to their open structure, the tripod/tri-pile foundations may not produce a wake effect as long as monopiles. Based on the spacing between the foundations (1.8 km x 1.8 km), the available information suggests limited opportunity for these areas to interact and overlap which is expected to limit the impact of the distribution of plankton to small, discrete areas within the New England Wind WFA. 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, 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.

As noted above, North Atlantic right whales are the only ESA listed obligate zooplanktivores in the action area, feeding almost exclusively on copepods, which are primarily aggregated by physical and oceanographic features. Based on observations of right whales and abundance of *C. finmarchicus*, Record et al. (2019) hypothesized that a 40,000 m^2 threshold for *C. finmarchicus* represents the regional copepod abundance at which high-density, exploitable, small-scale patches within a region are likely to occur. Mayo and Marx (1990) and Murison and Gaskin (1989) estimated the immediate decision-making threshold for right whale feeding to be approximately 1,000 m^3 for Cape Cod Bay and the Bay of Fundy, respectively. Kenney et al. (1986) estimated the minimum concentrations necessary for right whale feeding to provide a net energetic benefit over the long term to be in the 10^5–10^6 m^3 range. While we do not expect the presence and operation of the New England Wind WTGs and the foundations to affect the abundance of copepods in the WFA area or broader region, the distribution of copepods in the New England Wind WFA may be affected. This disruption would likely occur if/when there is consistent wind and water movement in a particular direction, as stable and consistent conditions have the greatest influence on wind facility induced effects. Given the predominant direction of water movement (west, depending on time of year) and wind flow (from the west, depending on time of year) and the potential area (up to 300 m from each foundation as described above) impacted by the presence of foundations, redistribution of prey in the New England Wind WFA would only be expected from foundation-driven turbulence under some conditions and only within an estimated 300 m of each foundation. We expect that these geographically limited impacts on the distribution of plankton could reduce the density of copepods and it is possible that density could be reduced below the feeding thresholds of right whales. Right whales have been observed feeding in well-mixed waters, however that feeding may not be as energetically efficient (O'Brien et al. 2021). Increased mixing may also increase the nutrient supply to the upper water column and in turn cause phytoplankton blooms, thus creating a food source for zooplankton. The increased turbulence may also form eddies in the wake of each foundation which will have uncertain effects on concentrating or dispersing zooplankton prey in a convergent current situation. However, given that the areas impacted by a single foundation turbulence would be limited to discrete areas within an estimated 300 m of each foundations and observed right whale foraging behavior is limited in the New England Wind WFA, we expect the collective effects – positive or negative from multiple turbine foundations on foraging right whales in the New England Wind WFA are unlikely to be biologically significant; that is, considering the best available information, and recognizing the existing uncertainty, we do not expect any effects on the distribution of copepods in the area to have any adverse effects on individual right whales. 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 not have adverse effects on any individual leatherback sea turtles foraging in the area.

Under stable conditions (i.e. sustained wind speed from a consistent direction), farther-field atmospheric effects may occur upwards of 100 km downwind of the New England Wind WFA, but the strongest impacts will likely be within 20-30 km (i.e. Gill et al. 2020, Christiansen et al. 2022, Floeter et al. 2022, Golbazi et al. 2022). From studies in the North Sea, these effects may include reduced wind speeds and wind stress and alterations to depth-averaged velocity, salinity, and sea-surface elevation (Christiansen et al. 2022). However, hub height of turbines and local ambient conditions may influence the extent of these effects. Given the predominant wind direction is from the west, with some variability from the northwest and southwest depending on time of year, under stable atmospheric conditions, we would expect any farther field effects to most commonly occur in parts of the Vineyard Wind 1 lease area and lease area OCS-A 0520 (Beacon Wind; see Figure 3.3) and also potentially beyond them to the northeast and east. The New England Wind WFA is directly southwest of the Vineyard Wind 1 lease area and directly west of lease area OCS-A 0520. Conditions are not expected to return to ambient between adjacent offshore wind projects (Christiansen et al. 2022). Under unstable conditions (i.e. variable wind speed from inconsistent direction(s)), these far field effects would be of reduced intensity and distance.

As described above, while there may be localized disruptions of zooplankton distribution due to the presence and operation of WTGs and their foundations, the overall biomass of resident zooplankton is not expected to change in a way that would be significant to ESA listed species, and supply of zooplankton from other regions, such as *Calanus finmarchicus,* is also not expected to be altered; this conclusion is reached in consideration of the anticipated effects of the New England Wind project and other offshore wind projects that we have completed ESA consultation for to date. Regional distribution of plankton may vary from pre-wind facility conditions; however, given the lack of a known bathymetric feature that aggregates zooplankton prey in the lease area and acknowledging the information and uncertainty presented here, we are not able to conclude that adverse effects on right whale foraging success due to near-field effects are reasonably certain to occur. Relative to far-field effects, we do not anticipate disruption to conditions that would aggregate prey in or outside the WFA that would have significant effects on ESA listed species. This is due to the scale of the project and its location in the center of the southern New England region and away from Nantucket Shoals and the tidal jet along the edge of Nantucket Shoals that are thought to aggregate zooplankton prey in that region. We have made this conclusion in consideration of the *Environmental Baseline,* which includes consideration of the operational effects of the offshore wind projects described as being in the action area (i.e., Vineyard Wind 1, South Fork, Revolution Wind, Sunrise Wind, Empire Wind, Ocean Wind 1, Atlantic Shores-South) and noting that the projects outside the MA/RI and MA WEAs (i.e., Empire, Ocean Wind, Atlantic Shores South) are not expected to affect conditions in the New England Wind WFA.

In summary, based on the best available scientific information pertaining to the effects of offshore wind facilities on oceanic and atmospheric conditions, and in recognition of the existing uncertainty related to the impacts as acknowledged herein, we expect the presence and operation of the proposed New England Wind project to have localized effects to the distribution and aggregation of the planktonic prey of listed species, however, we do not expect any overall reduction in the amount of prey in the WFA or action area. Local turbulence may have effects (positive or negative) on the ability of plankton to aggregate and their local distribution due to changes in primary production patterns. Given the predominant wind direction is from the west, with some variability from the northwest and southwest depending on time of year, under stable atmospheric conditions, we would expect any farther field effects to most commonly occur in parts of the Vineyard Wind 1 lease area and OCS-A 0520 lease area, both adjacent to the New England Wind WFA, depending on the predominant wind direction and also potentially beyond them to the northeast and east. Any effects to foraging individual right whales or leatherback sea turtles are not expected to be adverse and no take is anticipated to result from these effects.

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. Fin and sei whales feed on both small schooling fish and zooplankton, including copepods. We expect the New England Wind project to have localized effects on the distribution and aggregation of zooplankton prey species as described above; however, we do not expect any overall reduction in the amount of prey in the action area. Blue whales feed almost exclusively on krill; however, they occur primarily in deep offshore waters and are expected to be rare in the WFA, therefore there is a very low likelihood that any blue whales will be foraging in the area affected by the New England Wind project. Any effects to individual fin, sei, and blue whales are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. Effects to the benthic prey base of green, Kemp's ridley, and loggerhead sea turtles are extremely unlikely to occur as a result of the operations of the New England Wind project. We do not expect any impacts to the abundance or distribution of the cephalopods on which sperm whales forage as these prey typically occur further offshore and are free swimming. As no effects to sperm whale prey are anticipated, we do not expect any effects to sperm whales.

We note that as the scale of offshore wind development in southern New England and the greater Mid-Atlantic Bight region increases and the number of WTGs and foundations increases, the scope and scale of potential hydrodynamic impacts may also increase and influence the environmental baselines for future projects. We also note that development outside of this area (i.e., the Gulf of Maine) could affect regional patterns of zooplankton distribution, including copepods. Our Biological Opinions prepared for the Vineyard Wind 1, South Fork, Revolution Wind, Sunrise Wind, Empire Wind, Atlantic Shores South, and Ocean Wind 1, (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 environmental conditions 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 Vineyard Wind 1 project is planned as 62 WTGs and 1 ESP (63 total foundations) located directly northeast of the proposed New England Wind project. The presence of structures and operation of the Vineyard Wind 1 project may have oceanographic, hydrodynamic, and atmospheric effects that overlap or interact with the area affected by the New England Wind project, however, given the dominant wind direction, and the expected distance of these effects (and need for consistent and stable atmospheric conditions to induce such effects), we do not expect them to typically affect the conditions in the New England Wind WFA. The South Fork, Revolution Wind, and Sunrise Wind projects are approximately 37, 29, and 21 kilometers, respectively, to the west/northwest of the proposed New England Wind project. The South Fork Wind project will consist of 12 WTGs (13 total foundations), the Revolution Wind project will consist of up to 79 WTGs (up to 81 total foundations), and the Sunrise Wind project will consist of 84 WTGs (up to 85 foundations). Considering the anticipated effects of the New England Wind project in light of the WTGs and foundations of the South Fork, Revolution Wind, and Sunrise Wind projects, does not change our conclusions described above. Under conditions when wind is blowing consistently from the west, New England Wind may fall in the wind wake of these projects, this could reduce water column mixing in the New England Wind WFA, however this could be offset by mixing from the New England Wind foundations. The Empire Wind project is approximately 219 kilometers to the southwest of the New England Wind project, the Atlantic Shores-South project is approximately 330 kilometers to the southwest of the New England Wind project, and the Ocean Wind 1 project is approximately 350 kilometers to the southwest of the New England Wind project. Once built, we expect that these projects will be too far away for oceanographic, hydrodynamic, or atmospheric effects to impact the New England Wind WFA. Therefore, while in the future there may be additive 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

Park City will carry out survey and monitoring activities in and near the New England Wind WDA. As described in Section 3.0 of this Opinion, these will include: otter trawl, ventless trap surveys, neuston net sampling, and drop cameras to characterize fisheries resources in the WDA; and benthic monitoring to document the disturbance and recovery of marine benthic habitat and communities resulting from the construction and installation of New England Wind project components in the WDA and along the offshore export cable corridors. 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 potential 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 vessels, including the ones 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, Neuston Net Surveys, PAM, and Buoy Deployments

Benthic Sampling
Park City 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, including WTGs, ESPs, and their scour protection as well as the inter-array cabling and offshore export cable corridors from the WDA to shore. Monitoring will be conducted using a combination of acoustic survey and remotely operated vehicle (ROV) imaging techniques, along with grab sampling techniques. Surveys will be conducted at WTG-associated sites pre-construction and at 1, 3, and possibly 5 years post construction. All survey equipment will be deployed from contracted scientific research vessels. Targeted high-resolution acoustic surveys (SSS and MBES) will be conducted over the selected IAC corridors prior to boulder relocation and again after all construction is complete to map boulder locations within the survey areas. 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/ESP foundations, scour protection layers, and cable protection layers).

The ROV video and SPI/PV surveys will result in temporary disturbance of the benthos and temporary loss of benthic resources in the disturbed areas. ROV operation and SPI/PV surveys 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.

Acoustic Telemetry Monitoring
Park City will maintain six acoustic telemetry receivers within the New England Wind lease area and surrounding waters. This telemetry monitoring is designed to complement existing acoustic telemetry surveys currently in progress by New England Aquarium and INSPIRE Environmental. The receiver array will be maintained twice per year (in the spring and in the fall) over the six years of proposed surveys. This maintenance includes retrieving and re-deploying the receivers each time. No new capture or tagging of fish is proposed for this study. The receivers for these surveys will be set using ropeless technology; this means that there will be no vertical lines associated with the moorings and therefore, no risk for entanglement of listed species in the mooring systems. Operationally, the acoustic receiver devices just record the presence of nearby tagged animals.

No effects to ESA listed species are anticipated to result from acoustic telemetry surveys other than general vessel activities, the effects of which are considered in Section 7.2 above. This is because no listed species will be tagged and the deployed receivers will utilize ropeless technology negating any entanglement risk, and there are no effects to ESA listed species from this type of passive monitoring.

Drop Camera
Park City is proposing to conduct drop camera surveys following the NOAA sea scallop resource stock assessment methodology. Three cameras recording both digital still and video will be deployed to identify substrate as well as invertebrate and fish species associated with the sea floor. The survey will occur twice per year over six years between April and September each year. Park City will choose 182 impact sites and 186 control sites, or a total of 736 average annual samples (368 sampling stations per survey). Cameras, sampling pyramids, and lights will be deployed from a commercial scallop fishing vessel and the survey period will last approximately 6 days. No effects to ESA listed species are anticipated to result from the drop camera surveys other than general vessel activities, the effects of which are considered in Section 7.2 above.

Neuston Net Sampling
Zooplankton sampling will occur concurrent with the ventless trap surveys to determine the relative abundance and distribution of the larvae of commercially fished crustaceans. The surveys will use a towed neuston net and sample the top 0.5 m of the water column. At each ventless trap survey station (30 total), one ten-minute tow will be conducted at a target speed of four knots to assess pre-settlement and abundance of plankton resources in the New England Wind WDA and the adjacent control area (see Figure 3.3). The 2.4 m x 0.6 m x 6 m sampling net made with 1,320-microfiber mesh will be deployed off the stern of commercial fishing vessels from May to Decembers on the days baiting and setting gear will occur for the ventless trap surveys.

The small size of the sampling net, relative location of the sampling net in the water column, short tow times, and slow operational speeds makes the risk of capture of any ESA listed sea turtle or Atlantic sturgeon species extremely unlikely to occur; listed whales are too large to be captured by the sampling net. Based on the analysis herein, it is extremely unlikely that any ESA listed species will interact with the plankton survey activities; any effects to ESA listed species of the zooplankton survey activates are extremely unlikely to occur and thus discountable.

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, Appendix C 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 New England Wind 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

Park City will conduct up to six years of otter trawl surveys (up to 3 years pre/during construction and 3 years post-construction) to assess the finfish community in the New England Wind WFA and the adjacent reference areas. As described in Section 3.0, the surveys will be adapted to Northeast Area Monitoring and Assessment Program (NEAMAP) protocols. A total of 200 tows each year (50 trawls per season) will be split evenly between the New England Wind Farm WDA and the control areas. All surveys across the New England Wind WFA and the control areas will be conducted during daylight hours (after sunrise and before sunset) for 20 minutes each with a target tow speed of 3.0 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, blue, 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, blue, 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, blue, 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 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, blue 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). Blue whales feed on krill. The trawl gear to be used in the New England Wind 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 New England Wind WDA are the NEAMAP and NEFSC bottom trawl surveys. Both surveys occur in the spring and fall using trawl gear.

The NEFSC bottom trawl surveys use a 4-seam, 3-bridle bottom trawl to monitor abundance and distribution of mature and juvenile fish and invertebrates. The survey operates from Cape Hatteras to the Western Scotian Shelf and targets 800 tows per year over approximately 120 days at sea. The spring survey occurs from March to May, occasionally to June, and the fall survey occurs from September to November. In various forms, these surveys have been ongoing since 1963. Due to vessel and equipment limitations, the depth range minimum for more recent years is at least 18 m (60 feet).

The NEAMAP Near Shore Trawl Program is conducted in the spring (April – June) and fall (October – December). Each cruise samples approximately 150 stations across 15 regions from Cape Hatteras, NC north to Cape Cod, MA. Surveys occur in depths to 60 feet and includes the sounds to 120 feet (see map at https://www.vims.edu/research/units/programs/multispecies_fisheries_research/neamap/stations/index.php). This survey has been ongoing since 2007.

The NEAMAP survey area is just inshore of and does not overlap with the area that will be sampled for the New England Wind trawl surveys. 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 Wind Energy Areas located in southern New England. 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. New England Wind is proposing to carry out 200 tows total over four seasons (50 per season) each year. We do not expect sea turtles to occur in the area during the winter. Applying the fall capture rate to the 50 spring, summer and fall tows (150 total) (as we expect similar abundance of sea turtles in the area in the spring, summer and fall months), results in a prediction of 0.262 loggerheads captured per year or 1.57 loggerheads over the six 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 New England Wind 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 New England Wind trawl survey will use the same trawl design as the NEAMAP survey carried out by the Virginia Institute of Marine Science (VIMS); however, as noted above the NEAMAP survey area does not overlap with the New England Wind trawl survey areas as the NEAMAP survey area is further inshore. 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 and applying that to the number of tows planned by New England Wind, we would predict the capture of 1.67 loggerheads, 1.13 Kemp's ridley, zero leatherbacks, and 0.033 green sea turtles per year. Over the up to six year survey period, we would predict the capture of 10 loggerheads, 7 Kemp's ridley, zero leatherbacks, and 1 green sea turtles.

As explained above, we do not consider it reasonable to use commercial fisheries bycatch data to predict risk of capture in the trawl surveys; this is due to significant differences in operational protocols. As explained above, both the NEFSC trawl surveys and NEAMAP trawl surveys operate with similar gear and survey protocols as those planned for the New England Wind survey, with the New England Wind survey specifically designed to mimic the NEAMAP protocols. The New England Wind survey will occur outside (further offshore) of the area sampled in the NEAMAP survey and the depths in the area to be surveys are deeper than those targeted by the NEAMAP survey. The NEAMAP survey occurs in more inshore waters and, in most areas, with depths less than 60 feet while the NEFSC survey has a minimum survey depth of 60 feet. Depths in the New England Wind survey area are over 140 feet (COP Section 2). The depths and location of the area where the New England Wind surveys will take place suggests that the NEFSC survey data would be a better predictor of sea turtle interactions than the NEAMAP survey. 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 New England Wind survey to result in the capture of a leatherback sea turtle. We have also considered data from surveys being carried out in nearby wind lease areas; surveys have been ongoing in the Vineyard Wind 1 lease area and the South Fork lease area since Fall 2021, and more recently in the Revolution Wind lease area and the Sunrise Wind lease area since Fall 2023. To date, no captures of sea turtles in these trawl surveys have been recorded. We note that two (live, uninjured) loggerheads were collected in Ocean Wind 1's fall 2023 trawl survey; however, that survey area is hundreds of miles south of the New England Wind survey area. Based on our consideration of the best available information, as laid out here, we consider the NEFSC trawl survey data to be the best means to predict future captures of sea turtles in the New England wind trawl surveys. As such, we expect the capture of up to 2 sea turtles over the 6 year survey period (Table 7.5.1). These are most likely to be loggerheads but given the distribution of other sea turtle species in the area and the documented interactions with trawl survey gear, it is also possible that these could be Kemp's ridley or green sea turtles.

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 NEFSC trawl surveys (no mortalities or serious injuries), a 20-minute tow time for the bottom trawl gear to be used in the proposed New England Wind 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 minor 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 New England Wind trawl surveys over the six-year duration

Species	Total Estimated Captures Over Six Years
Loggerhead, Kemp's ridley, or Green	2
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 New England Wind 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 New England Wind WDA are the NEAMAP and NEFSC bottom trawl surveys. As explained above, the NEAMAP survey area is farther inshore and does not overlap with the New England Wind survey area 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 200 tows planned for the New England Wind surveys predicts 0.225 Atlantic sturgeon captured per year. Over a six year survey period, this would result in a predicted total capture of 1.35 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 22 Atlantic sturgeon per year in the New England Wind surveys, resulting in a total predicted capture of 132 Atlantic sturgeon over the course of the six year survey period.

As noted above, trawl surveys are underway in the South Fork, Vineyard Wind 1, Revolution Wind, and Sunrise Wind lease areas, with the Revolution Wind and Sunrise Wind surveys having completed only one season to date (Fall 2023). To date, five Atlantic sturgeon have been captured in the South Fork trawl surveys (2 in May 2022, 1 in July 2022, and 2 in May 2023). Given that the New England Wind survey will use the same methods and that the New England Wind control area is adjacent to the South Fork lease area, these captures indicate that using the NEFSC survey data to predict future interactions with Atlantic sturgeon in the New England Wind trawl surveys would result in an underestimate.

As noted above, we are not aware of any other survey data that could be used to predict interaction rates for Atlantic sturgeon in the New England Wind lease area. The Massachusetts nearshore trawl survey occurs in waters inshore of the New England Wind survey area (see map of 2023 sample locations at https://www.mass.gov/files/documents/2023/07/11/MLA_Letter_fall_2023.pdf). Dunton et al. (2015) calculated catch per unit effort (CPUE; fish per minute towed) for Atlantic sturgeon captured in trawls off the south coast of Long Island; CPUE is reported for both trawls carried out in a stratified random sampling design and trawls targeting Atlantic sturgeon. The study reports catch of 149 Atlantic sturgeon for 10,380 minutes of trawling in the stratified random sampling design; this translates to 0.0144 Atlantic sturgeon/minute. CPUE from targeted trawling was 0.226 sturgeon/minute. The area surveyed by Dunton is a high use area for Atlantic sturgeon and thus is not expected to be representative of catch rates in the New England Wind survey area where Atlantic sturgeon are expected to be transient and be less common given the deeper, more offshore location.

Given the geographic distribution of the proposed New England Wind 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, as noted above the capture rate of ongoing surveys in the area suggest that the NEAMAP survey data would be a better predictor of sturgeon interactions than the NEFSC survey which appears likely to undercount the number of interactions for this area. As explained above, we have determined that using the NEFSC trawl survey data is likely to underestimate Atlantic sturgeon captures. Therefore, absent any other data source, we have determined that using the NEAMAP data provides the best predictor of the number of Atlantic sturgeon likely to be captured in the New England Wind trawl surveys. As such, we expect up to 132 Atlantic sturgeon will be captured over the six 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 New England Wind 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 132 Atlantic sturgeon expected to be captured in the New England Wind trawl surveys and 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 minor injuries 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 New England Wind 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 Six Years
Total	132
New York Bight (55.3%)	73
Chesapeake (22.9%)	30
South Atlantic (13.6%)	18
Carolina (5.8%)	8
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 and thus discountable.

7.5.3 Assessment of Risk of Interactions with Ventless Trap Survey
As described in Section 3.0, ventless trap gear will be used in a BACI sampling design to evaluate changes in the distribution and abundance of in Jonah crab, lobster, rock crab, and black sea bass in the New England Wind WDA and adjacent reference areas. The BACI trap survey will be conducted with 15 6-trap trawls (multiple traps linked together by sinking groundline) in the two impact areas within the New England Wind WFA and 15 6-trap trawls within the two control areas that will be sampled twice per month (3-day soaks) to the degree possible from May-December. Each trawl will be comprised of three ventless traps and three standard vented traps alternating in the string. The survey will sample 30 random depth-stratified stations distributed throughout the development and control area in a BACI design. Station locations will be reselected each year. 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 New England Wind ventless trap survey impact area as well as predation rate of black sea bass on lobsters. During the operational phase of the project, fifteen foundation locations in the New England Wind ventless trap survey impact area will be selected at random, and six trap trawls of ventless traps will be intentionally set with the mid-point of the trawl as close to the foundation as possible, along with fifteen traps placed in two control areas adjacent to the WFA. Each randomly selected foundation location will be sampled once per month (3-day soaks). The survey will follow the same protocols and sampling season (May-December) as the BACI survey. All trap gear will follow all applicable regulations and will 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 monthly survey periods and at the end of the survey season. Neuston net sampling for zooplankton will be done in conjunction with ventless trap surveys at the 30 stations across the WDA and control areas; effects of this survey were addressed above.

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 trap survey gear; thus, there will be no vertical 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. We note that neither the BA or the survey plan describe any other vertical lines associated with the survey and any modification to include traditional vertical lines, either attached to the survey gear or adjacent or alongside it to "mark" the location is not considered here. Any such change to the proposed action would require reinitiation of this consultation.

Blue, Sei, and Sperm Whales
Blue, 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 blue or 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 blue, 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 blue, 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 blue, sei, and sperm whales in the survey area, the relatively small amount of gear (30 total trawls with 6 traps each periodically deployed between May-December each year) that will be utilized over the course of six years, and ropeless trap gear (with no vertical lines or buoys) that will be used and thus require a blue, sei, or sperm whale to physically interact with the groundline resting on the seafloor, it is extremely unlikely that a blue, sei, or sperm whale would encounter this gear; therefore, effects are discountable. Therefore, we do not expect the entanglement of any blue, sei, or sperm whales to occur in the gear set for New England Wind's 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 – December, 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 there 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-December), 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 (30 total trawls with 6 traps periodically deployed between May-

December each year) that will be utilized over the course of six years, the ropeless trap (with no vertical lines or buoys or weak link trap gear) 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. Therefore, 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 New England Wind 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 and effects from entanglement are therefore discountable.

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 New England Wind 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 the 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 New England Wind 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 Park City 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 16 inches high, 40 inches long, and 21 inches wide with 5-inch entrance hoops and constructed with 1-inch square rubber coated 12-gauge wire, 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 New England Wind 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 Park City will have an effect on Atlantic sturgeon prey.

7.5.4 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, ventless traps, and drop cameras will be set on the ocean floor, which could result in disturbance of benthic resources. Acoustic receivers 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 otter trawl and drop cameras may 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 high levels compared to the larger surrounding region (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), dredge (clam and scallop) and hook and line. Fisheries include: American lobster, Atlantic herring, Atlantic sea scallops, Atlantic surfclam, bluefish, Jonah crab, hakes, squid, butterfish, channeled whelk, summer flounder, scup, black sea bass, Atlantic mackerel, skates, striped bass, tautog, weakfish, winter flounder, bonito, cunner, spot, conger eel, sea robbins, and spiny dogfish (BOEM 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 England Wind lease area, the bottom trawl, lobster pots, and gillnets targeting multiple species, was the primary commercial fishing gear utilized in terms of value and landings. Of the species for which data can be shared due to requirements to protect confidentiality, the most landed commercial fishery in pounds was the longfin squid, which was also the most economically valuable species within the New England Wind Lease Area (NE Wind COP, NOAA 2019c, ACCSP 2019). 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 monkfish, sea scallop, squid, flounders, hakes, and Atlantic herring. Based on the VMS data, most of the commercial fishing activity for herring, squid, hakes, and groundfish species (flounders and skates) is located in the western and southeastern portions of the New England Wind Lease Area and export cable corridor, with monkfish being widespread throughout the lease area and scallop activity focused in the central and eastern portions of the lease area. 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 3.9 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 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 habitat conversion, safety concerns operating around structures, and other factors that may affect access (increased user conflicts, increased insurance rates, etc.).

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., Atlantic cod, longfin squid), 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 naturally variability of the fisheries, fisheries impacts related to habitat impacts are likely to be related to the footprint of temporary and permanent disturbance impacted by construction or decommissioning (BOEM 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 ESPs 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 (approximately 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, 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 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 Atlantic herring and sea scallop 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 longfin squid, effort may shift northeast or southwest outside of the WDA to other areas of similar squid availability south of Martha's Vineyard/Nantucket and Long Island.

Fishing vessel activity (transit and active fishing) is high throughout the southern New England region and Mid-Atlantic Bight as a whole, with higher levels of effort occurring outside of the WDA than within the WDA. The scale of the proposed Project (up to 1320 WTG and ESP foundations) and the footprint of the lease area (101,590-111,939 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 ESP 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 New England 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 New England Wind Farm is planned to be built overlaps with popular recreational fishing spots such as the "31 Fathom Hole" and the northeast corner of "The Dump." 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 foundations (132) 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[46], 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.

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.

7.7 Repair and Maintenance Activities

New England Wind personnel conducting O&M activities would access the lease area on an as-needed basis. With no personnel living offshore, the WTGs would be remotely monitored and controlled by the Supervisory Control and Data Acquisition (SCADA) system. 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

[46] https://boston.cbslocal.com/2021/07/13/block-island-whale-boat-rescue/

Effects of Project Vessels section 7.2 above. Effects of noise associated with project vessels and aircraft are addressed in the acoustics section 7.1 above; these effects were determined to be insignificant.

Project components would be inspected routinely with the frequency dependent on the component (see Table 3.3-4 in the COP). Underwater inspection may 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. New England Wind states that preventative maintenance activities will be planned for periods of low wind and good weather (typically in the spring and summer).

BOEM has indicated that given the burial depth (5-8 ft., 1.5-2.5 m, below sea floor) of the inter-array cable and the New England Wind Export Cable-Offshore, displacement, or damage by vessel anchors or fishing gear is unlikely. Mechanical inspections of the New England Wind Export Cable would include a cable burial assessment and debris field inspection. New England Wind would perform mechanical inspections on a 3 to 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. This conclusion is made in consideration of any repairs or additions to cable protection that is placed during cable installation.

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 (COP 2022).

7.8 Unexpected/Unanticipated Events

In this section, we consider the “non-routine activities and low probability events” that were identified b in the New England Wind 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 ESPs, 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 and not reasonably certain 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 an ESP 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 to occur.

7.8.2 Failure of WTGs due to Weather Event

As explained in the COP (2022) and DEIS (Section 2.3), Project components are designed 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. As described in COP Volume I, the WTGs and ESPs are designed to site-specific conditions in accordance with international and United States (US) standards and the designs will be reviewed by a third-party Certified Verification Agent (CVA) that certifies the design conforms to all applicable standards. The Phase 1 and Phase 2 WTG design will be verified for the specific site conditions during the CVA review process (see COP Section 3.2.3.2), where the design will be able to withstand wind speeds and gusts anticipated at the SWDA (see Appendix I-E). The WTGs will be designed to automatically stop power production when wind speeds exceed a maximum value, after which the rotor will normally idle. The exact speed at which power production will cease depends on the manufacturer's specifications. The structures will be designed for the extreme environmental conditions (including wind speed and wave height) verified by the CVA.

BOEM has indicated that the proposed WTGs will be designed in accordance with the International Electrotechnical Commission (IEC) 61400-1 and 61400-3 standards. These standards require designs to withstand forces based on site-specific conditions for a 50-year return interval (2% chance occurrence in a single year) for the WTGs, which corresponds to a Category 3 hurricane in this area. This means that the WTGs are designed not merely for average conditions but for the higher end event that is reasonably likely to occur. The newly revised IEC standard now also recommends a robustness load case for extreme metocean conditions, where the WTG support structures are checked for a 500-year event (0.2% chance occurrence in a single year), which corresponds to wind gusts at the strength of a Category 5 hurricane, to ensure that the appropriate level of safety is maintained in case of a less likely event. The Project would be constructed using a certified verification agent to ensure that all design specifications are met (BOEM 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 25-35 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 25-35 years, any associated potential impacts to listed species are also extremely unlikely to occur.

7.8.3 Failure of WTGs due to Seismic Activity

The Project is not within an active plate boundary area associated with an elevated seismic hazard, however earthquakes can occur in intra-plate areas. Seismic activity was documented from a review of the Northeast States Emergency Consortium (NESEC) data. NESEC states that approximately 40 to 50 earthquakes are detected annually in the Northeast, which includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont (NESEC 2017a). Regionally, there has been one occurrence of seismic activity of a magnitude or intensity 4 or greater since 1965, recorded in East Hampton, New York, in March 1992 (NESEC 2017b). 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.

7.8.4 Oil Spill/Chemical Release

As explained in the Oil Spill Response Plan (OSRP) (COP Section 3.3.4.3; Appendix I-F), the OSRP provides clear notification and activation procedures and identifies shore-based resources to respond to an oil spill or the substantial threat of an oil discharge from any New England Wind offshore wind turbine generator and electrical service platform. As described in the COP, the worst-case discharge scenario would be a structural failure of an 804 MW electrical service platform within the Phase 1 portion of the SWDA. The worse-case discharge scenario associated with the Phase 2 portion of the SWDA would be a structural failure of a 1,200 MW electrical service platform. A structural collapse would cause a subsequent rupture of the transformers oil reservoirs within the ESPs. The oil sources associated with one 804 MW ESP and one 1,200 MW ESP totals an approximate release of 124, 097 gallons and 185, 978 gallons respectively. Similarly, the structural failure of a WTG resulting in collapse and damage that released oil products would in the worst case, release approximately 3, 162 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 ESPs and the WTGs have been designed with secondary containment for all identified oils, grease, and lubricants (COP 2022). 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 an extremely small chance (on the order of 1 in ≥ 1, 000 years) of a "catastrophic release" of oil from the wind facility in any given year. Given the 35-year life of this project, the modeling supports our determination that such a release is extremely unlikely to occur.

The COP (Volume I, Appendix I-F; Epsilon 2022) presents results from a spill model assessing the trajectory and weathering of spilled material following a catastrophic release of all oil contents from an offshore ESP located at the closest potential position to shore from the WDA. Each WTG would contain up to 17, 413 galls of oils, lubricants, coolant, and diesel fuel, while each ESP could contain up to 189, 149 gallons of these fluids. 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. Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures, the probability of occurrence of this type of catastrophic release, such as the structural failure of an ESP, is very low (on the order of 1 in ≥ 1,000 years). Considering the predicted frequency of such events 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 or ESP fluid spill is extremely unlikely; as such, any exposure of listed species to any such spill is also extremely unlikely and thus discountable.

7.9 Project Decommissioning

As described in the BA and DEIS, under 30 CFR Part 585 and Park City's lease, New England Wind 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 ft. (4.6 m) below the mudline (30 CFR § 585.910(a)). The portion buried below 15 ft. (4.6 m) would remain, and the depression refilled with the temporarily removed sediment. BOEM expects that WTGs and the ESPs would be disassembled and the piles cut below the mudline. New England Wind 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 New England Wind 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 mudline.

Information on the proposed decommissioning is very limited and the information available 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. We note that prior to decommissioning, New England Wind would be required to submit a decommissioning plan to BOEM. According to BOEM, 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. New England Wind 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 plan 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 1.4.3 of the BA, it is anticipated that the equipment and vessels used during decommissioning will likely be similar to those used during construction and installation. 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 and ESP structures. Effects of the vessel traffic anticipated for decommissioning are addressed in the vessel effects section of this Opinion. As described below, based on the information available at this time, we have determined that all other effects of decommissioning will be insignificant.

As described in Sections 3.3.3 – 3.3.3.5 of the COP, decommissioning of the New England Wind offshore facilities is broken down into several steps. Decommissioning steps include: (1) retirement in place (if authorized by BOEM) or removal of the offshore cable system (i.e. inter-array, inter-link, and offshore export cables) and any associated cable protection, (2) dismantling and removal of WTGs, (3) cutting and removal of foundations and removal of scour protection; (4) removal of ESPs (topsides and foundations). Please reference the COP (sections 3.3.3-3.3.3.5) for further details on the decommissioning plan and procedures.

As described in the BA and COP, cable removal would largely be the reverse of cable installation. 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. WTGs and ESPs would be dismantled with as many parts as possible being recycled.

Sediments inside the pile 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. 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. 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.

In general, waters in the project area are warming and are expected to continue to warm over the 25-to-30-year life of the New England Wind project. 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). 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 (44097) 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 (BOEM 2023). Based on current predictions (IPCC 2014[47]), this could shift to a range of 7.9°C in the winter to 23.8°C in the summer. 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

[47] IPCC 2014 is used as a reference here consistent with NMFS 2016 Revised Guidance for Treatment of Climate Change in NMFS Endangered Species Act Decisions (Available at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act-guidance-policies-and-regulations, last accessed March 2, 2023).

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 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 et al. 2016). 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 m 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 England 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 New England Wind 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, Empire Wind, Sunrise Wind, Revolution Wind, and Atlantic Shores South 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 substantially similar effects in the action area are and that are reasonably certain to occur: 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 the Gulf of Maine DPS of Atlantic salmon and will have no effect on critical habitat designated for the North Atlantic right whale. We concluded that the proposed action is not likely to adversely affect giant manta rays, hawksbill sea turtles, oceanic whitetip sharks, and critical habitat designated for the New York Bight DPS of Atlantic sturgeon. 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, for the species not addressed in section 4, 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 the context of climate change and the *Status 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, blue, 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.

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 and the Hudson River where vessel transiting to/from the ports in Albany and Coeymans, NY 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 New England Wind project 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 New England Wind project 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 New England Wind project.

The only other effects of the action that shortnose sturgeon would be exposed to are vessel transits in the Hudson River. We have determined that those effects are extremely unlikely to occur and discountable. We have not identified any adverse effects of the New England Wind project on shortnose sturgeon that are beyond (i.e. different or in addition to) what was considered in the Paulsboro Opinion. As such, consistent with the conclusions of the Paulsboro consultation we have determined that the proposed actions considered here are likely to adversely affect but not likely to jeopardize the continued existence of shortnose sturgeon.

9.2 Atlantic sturgeon

In the *Effects of the Action* section above, we determined that 2 Gulf of Maine, 73 New York Bight, 30 Chesapeake Bay, 18 South Atlantic, and 8 Carolina DPS Atlantic sturgeon are likely to be captured and released alive with only minor, recoverable injuries during the approximately 6 year period that the trawl surveys take place. While exposure to foundation installation noise (drilling, vibratory and impact pile driving) and UXO detonations 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 New England Wind project vessels utilizing the Paulsboro Marine Terminal will strike and kill up to one New York Bight DPS Atlantic sturgeon while transiting the Delaware River. The effects of these vessel trips and the loss of this individual 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 throughout the action area, including the Hudson River.

9.2.1 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”[48] 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.

[48] 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

The effects of the proposed New England Wind 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 New England Wind 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 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, drilling, UXO detonation 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 GOM DPS Atlantic sturgeon in the action area. All effects to GOM 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 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. There will be no effects on reproduction. 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 in the WDA with increased noise during foundation installation and UXO detonation.

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 "Improvement in the status of listed species to the point at which listing [as threatened or endangered] is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 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 necessary to be listed as a threatened species 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[49]). 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

[49] Available online at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed December 1, 2023

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 foundation installation or UXO detonation 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 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.

9.2.2 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 New England Wind 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 1 New York Bight DPS Atlantic sturgeon from New England Wind project vessels transiting within the Delaware River to/from the Paulsboro Marine Terminal, the only adverse effects of the proposed action on Atlantic sturgeon New York Bight DPS are the non-lethal capture (and release) of up to 73 New York Bight DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving, drilling, UXO detonation 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 1 strike anticipated in the Delaware River/Delaware Bay addressed in the Environmental Baseline. No vessel strikes are anticipated to result from New England Wind vessels operating in the Hudson 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 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 1 New York Bight DPS Atlantic sturgeon resulting from New England Wind project 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 drilling, pile driving, or UXO detonation.

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 1 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 "Improvement in the status of listed species to the point at which listing [as threatened or endangered] is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 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 or endangered; 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.

9.2.3 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 New England Wind 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 Atlantic sturgeon are the non-lethal capture of up to 30 Chesapeake Bay DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving, drilling, UXO detonations, 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. 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 Chesapeake Bay DPS Atlantic sturgeon. There will be no effects on reproduction. 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, drilling, and UXO detonation.

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 "Improvement in the status of listed species to the point at which listing [as threatened or endangered] is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 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 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 or endangered; 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.

9.2.4 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[50] 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

[50]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).

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 New England Wind 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 8 Carolina DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving, drilling, UXO detonation 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 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 "Improvement in the status of listed species to the point at which listing [as threatened or endangered] is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 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.

9.2.5 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 New England Wind 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 South Atlantic DPS Atlantic sturgeon are the non-lethal capture of up to 18 South Atlantic DPS Atlantic sturgeon in the trawl survey. We do not anticipate any adverse effects to result from exposure to pile driving, drilling, UXO detonations, 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. 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 "Improvement in the status of listed species to the point at which listing [as threatened or endangered] is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." . 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 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.

9.3 Sea Turtles

Our effects analysis determined that impact pile driving noise and UXO detonations are 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 serious injury, or mortality is anticipated. A small number of North Atlantic DPS green, leatherback, and Northwest Atlantic DPS loggerhead sea turtles will experience PTS as a result of exposure to impact pile driving noise. 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 22 leatherback, 28 NWA DPS loggerhead, 2 NA DPS green, and 2 Kemp's ridley sea turtles over the 37-year life of the project, inclusive of the construction, operation, and decommissioning period. We expect that up to 2 sea turtles (some combination of NWA DPS loggerhead, NA DPS green, and 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 past and ongoing actions affecting listed sea turtles in the action area and which are expected to generally continue for the foreseeable future, as Cumulative Effects, affecting each of these species of sea turtle 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 37-year life of the New England Wind 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.

9.3.1 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 up to 28 individuals due to vessel strike over the 37-year construction, operations and decommissioning period; the capture of up to 2 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); the harm of 2 loggerheads as a result of experiencing PTS due to exposure to impact pile driving noise; and, the exposure of up to 11 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 28 Northwest Atlantic (NWA) DPS loggerheads over the 37-year life of the project.

The 11 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 or UXO detonation noise (as relevant for the exposure). 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 long-term 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 (approximately 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).

Modeling predicts that up to 2 NWA DPS loggerheads will be exposed to noise during pile driving that is loud enough to result in permanent threshold shift (PTS). PTS is auditory injury; therefore, it meets the definition of harm in the context of ESA "take." PTS is expected to consist of minor degradation of hearing capabilities occurring predominantly at the 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), and 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 (i.e., a noise would need to be a bit louder, or an animal would need to be closer to it, in order to hear it); severe hearing impairment or total hearing loss is not an expected outcome. As explained above, sea turtles do not vocalize and therefore do not rely on hearing for communication. As with TTS, we expect that the hearing loss associated with PTS may affect the ability of an affected individual to detect acoustic cues that are used to perceive the environment around them. This, in turn, may affect the ability of an affected individual to avoid threats. However, given that we only expect a minor loss of hearing sensitivity and not complete hearing impairment, we do not expect this loss of hearing sensitivity to prevent the affected individuals from detecting and avoiding threats; therefore, it is unlikely that the loggerheads that experience PTS will be less likely to survive than other loggerheads. With this minor degree of PTS, we do not expect it to affect any of the individuals' overall health, reproductive capacity, or survival. The two individuals experiencing PTS could be less efficient at detecting environmental cues which could theoretically impact their ability to avoid predators or other threats, but that risk is considered low. 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 and nesting, or survival of any of the 2 loggerheads that experience PTS.

The mortality of 28 loggerhead Northwest Atlantic DPS sea turtles in the action area over the 37-year life of the project (inclusive of up to 5 years of in-water construction, 30 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 28 NWA DPS loggerheads over the 37 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 28 individuals would represent approximately 0.18% of the population. If the total NRU population was limited to 1,272 sea turtles (the number of nesting females), and all 28 individuals originated from that population, the loss of those individuals would represent approximately 2.2% 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 28 individuals over 37 years is extremely small and would be even smaller when considered for all sea turtles (i.e., adult nesting females plus males and all younger year classes) 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 up to 28 NWA DPS loggerheads over the 37-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 28 loggerheads represents an extremely small percentage of the DPS as a whole; (2) the death of 28 loggerheads will not change the status or trends of any recovery unit or the DPS as a whole; (3) the loss of 28 loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 28 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 28 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.

9.3.2 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 1 individual due to exposure to pile driving noise as well as the harm of 1 individual due to exposure to pile driving noise (due to PTS, a permanent auditory injury); the mortality of 2 individuals due to vessel strike over the 37-year life of the project inclusive of construction, operations, and decommissioning; and, the capture of up to 2 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 37-year life of the project.

The 1 green sea turtle that experiences harassment would experience behavioral disturbance and could suffer temporary hearing impairment (TTS); we also expect this turtle 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 long-term 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 (approximately 4 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).

Modeling predicts that no more than 1 North Atlantic DPS green sea turtle will be exposed to noise during pile driving that is loud enough to result in permanent threshold shift (PTS). PTS is auditory injury; therefore, it meets the definition of harm in the context of ESA "take." PTS is expected to consist of minor degradation of hearing capabilities occurring predominantly at the 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), and 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 (i.e., a noise would need to be a bit louder, or an animal would need to be closer to it, in order to hear it); severe hearing impairment or total hearing loss is not an expected outcome. As explained above, sea turtles do not vocalize and therefore do not rely on hearing for communication. As with TTS, we expect that the hearing loss associated with PTS may affect the ability of an affected individual to detect acoustic cues that are used to perceive the environment around them. This, in turn, may affect the ability of an affected individual to avoid threats. However, given that we only expect a minor loss of hearing sensitivity and not complete hearing impairment, we do not expect this loss of hearing sensitivity to prevent the affected individuals from detecting and avoiding threats; therefore, it is unlikely that the green sea turtle that experiences PTS will be less likely to survive than other green sea turtles. With this minor degree of PTS, we do not expect it to affect the individuals' overall health, reproductive capacity, or survival. The individual turtle could be less efficient at detecting environmental cues which could theoretically impact their ability to avoid predators or other threats, but that risk is considered low. 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 and nesting, or survival of the green sea turtle that experiences PTS.

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 37-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.

9.3.3 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 8 individuals due to exposure to impact pile driving noise and UXO detonation (6 pile driving, 2 UXO) and harm (PTS) of up to 5 individuals as a result of exposure to impact pile driving noise. We also expect that 22 leatherbacks will be struck and killed by a project vessel over the 37-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 37-year life of the project, we anticipate the proposed action will result in the mortality of up to 22, harm of up 2, and the harassment of 8 (inclusive of TTS) leatherback sea turtles.

The 8 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 noise from pile driving or UXO detonation, as relevant for the exposure. 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 long-term 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 (approximately 4 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).

Modeling predicts that up to 5 leatherbacks will be exposed to noise during pile driving that is loud enough to result in permanent threshold shift (PTS). PTS is auditory injury; therefore, it meets the definition of harm in the context of ESA "take." PTS is expected to consist of minor degradation of hearing capabilities occurring predominantly at the 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), and 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 (i.e., a noise would need to be a bit louder, or an animal would need to be closer to it, in order to hear it); severe hearing impairment or total hearing loss is not an expected outcome. As explained above, sea turtles do not vocalize and therefore do not rely on hearing for communication. As with TTS, we expect that the hearing loss associated with PTS may affect the ability of an affected individual to detect acoustic cues that are used to perceive the environment around them. This, in turn, may affect the ability of an affected individual to avoid threats. However, given that we only expect a minor loss of hearing sensitivity and not complete hearing impairment, we do not expect this loss of hearing sensitivity to prevent the affected individuals from detecting and avoiding threats; therefore, it is unlikely that the leatherbacks that experience PTS will be less likely to survive than other leatherbacks. With this minor degree of PTS, we do not expect it to affect any of the four individuals' overall health, reproductive capacity, or survival. The four individual leatherbacks could be less efficient at detecting environmental cues which could theoretically impact their ability to avoid predators or other threats, but that risk is considered low. 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 and nesting, or survival of any of the up to 5 leatherbacks that experience PTS.

As noted above, the proposed project is expected to result in the mortality of no more than 22 leatherbacks. The death of 22 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 0.11% 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 these deaths 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 22 leatherbacks over 37-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 22 leatherbacks over the 37-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 22 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 22 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 22 leatherback is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 22 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 22 leatherbacks over the 37-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.

9.3.4 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 1 individual due to exposure to impact pile driving noise. We also expect that 2 Kemp's ridley sea turtles will be struck and killed by a project vessel over the

37-year life of the project inclusive of construction, operations, and decommissioning. We expect the capture of up to 2 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 2 Kemp's ridley sea turtles over the 37-year life of the project.

The 1 Kemp's ridley sea turtle 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 long-term 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 (approximately 4 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 2 Kemp's ridleys over a 37 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 2 Kemp's ridleys represents less than 0.03% of the nesting female population. While the death of 2 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 2 Kemp's ridley sea turtles over 37 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 2 Kemp's ridley sea turtles over 37 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 2 Kemp's ridleys represents an extremely small percentage of the species as a whole; (3) the death of 2 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[51];
2. An increase in the recruitment of hatchlings[52];
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 2 Kemp's ridleys over the 37-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

[51]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

[52] 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).

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.

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 2 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 foundation installation (drilling, pile driving) and UXO detonation (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 foundation installation (drilling, impact and vibratory 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 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. We determined that impact pile driving and UXO detonation is likely to result in minor auditory injury (permanent threshold shift, a small but permanent loss of hearing sensitivity) of a number of blue, fin, and sei whales that meets the definition of harm in the context of ESA take. 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 New England Wind 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, blue, fin, sei, and sperm whales resulting from the proposed action are from sounds produced during drilling and pile driving to install WTG and ESP foundations and to detonate up to 10 UXOs. 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 foundation installation and UXO detonation 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 exposure of any individuals in this case. Any repeated exposure would be limited to individuals experiencing minor TTS in a subsequent construction season after fully recovering from exposure the previous year.

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). 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 37-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 New England Wind 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 for the New England Wind project 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 New England Wind project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with a number of 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 (50 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, clearance and shutdown measures during foundation installation and clearance measures during UXO detonation monitored by PSOs on multiple platforms, reduce the potential for exposure of right whales to noise above thresholds of concern during foundation installation and UXO detonation. 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 up to 101 exposures of North Atlantic right whales over the three to five year construction period that would result in TTS and/or temporary behavioral disturbance (up to approximately 4 hours considering the time to install each pile, recognizing that pile driving will occur for 4 to 16 hours per day) and associated temporary physiological stress during the construction period due to exposure to noise from foundation installation (74 exposures) and UXO detonations (27 exposures). 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). Given the number of exposures anticipated and the three to five year construction period (with foundation installation occurring over two or three construction seasons and UXO detonations occurring in up to two construction seasons), we expect that some individuals may be exposed to project noise in more than one year; however, we expect full recovery between exposures such that there would be no cumulative or additive effects experienced by the individual whale. This is due to the minor and temporary nature of the TTS and behavioral response, inclusive of stress.

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 101 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 UXO detonation or foundation installation 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. 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 foundation installation noise). In addition, as explained in section 7.1, we do not expect that avoidance of project 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 foundation installation or UXO detonation 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 foundation installation 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 foundation installation 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 foundation installation would only last for the duration of the exposure to foundation installation; approximately 4 hours for a single pile, 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 74 right whales exposed to levels of noise during foundation installation will return to normal behavioral patterns after the exposure ends. As such, even if a right whale exposed to foundation installation noise was foraging, this disruption would be short term and impact no more than one foraging event on a single day. Behavioral response for the 27 right whales exposed to noise above the TTS threshold during UXO detonations is expected to be limited to a minor startle response; this is due to the short duration of that noise (less than one second).

Installation of a single pile will take approximately 4 hours while complete installation of jacket foundation will take up 16 hours (4 hours for each of 4 pin piles); as explained in section 7.1, exposure to noise for more than 4 hours is not expected to occur considering the area where noise will be elevated and the anticipated swim speed and behavioral response (avoidance),. An animal exhibiting the anticipated avoidance response to foundation installation 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.

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 New England Wind 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 foundation installation (up to 74 exposures) and UXO detonation (up to 27 exposures). 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 101 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 of 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 long-term fitness consequences to any of the up to 101 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 New England Wind project; therefore, we do not expect this harassment to reduce the likelihood of successful migration, breeding, calving, or nursing. These conclusions do not change even considering that some individuals may experience TTS and behavioral disturbance that meets the definition of harassment in more than one construction season; as explained above, this is because we expect full recovery of hearing and resolution of stress response within a week therefore there are no cumulative or additive effects anticipated.

In summary, while we expect the proposed action to result in the harassment of 101 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 foundation installation noise or UXO detonations 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 the individuals exposed to foundation installation 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 33 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 New England Wind project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment) as a result of exposure to noise from foundation installation (drilling, pile driving) and UXO detonations; 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 352 individual fin whales as a result of exposure to noise from impact pile driving (TTS and behavioral disruption), and 16 fin whales as a result of exposure to UXO detonations (TTS), that is below the Level A harassment threshold but above the Level B harassment threshold. With the exception of the 33 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 37-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 New England Wind 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 for the New England Wind project 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 New England Wind 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 foundation installation and UXO detonations, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during foundation installation and UXO detonations 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 33 fin whales to experience PTS due to impact pile driving noise and up to 368 fin whales to experience TTS, temporary behavioral disturbance and associated temporary physiological stress during the construction period due to exposure to foundation installation noise or UXO detonations (352 for foundation installation and 16 for UXO detonations).

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 33 fin whales estimated to be exposed to impact 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 33 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 33 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 33 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 368 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 long-term 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 exposure to noise from New England Wind 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 foundation installation noise). Also, as explained in section 7.1, we do not expect that avoidance of foundation installation 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 project 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 foundation installation noise may mask fin whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to foundation installation 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 foundation installation noise would only last for the duration of the exposure to foundation installation noise, approximately 4 hours per pile 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 on available 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 fin whales 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 foundation installation 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 4 hours; therefore, even in the event that the 352 fin whales expected to be exposed to foundation installation noise were exposed to disturbing levels of noise for the entirety of an event, that disturbance would last approximately 4 hours. While pile driving may occur for 4 to 16 hours per day, as explained in section 7.1, 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 foundation installation 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. Behavioral response for whales exposed to UXO detonations is expected to be limited to a minor and temporary startle response due to the very short duration of the detonation (less than one second).

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 368 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 368 individual fin whales; the only injury anticipated is of the up to 33 fin whales that are expected to experience PTS due to exposure to impact 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 New England Wind 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 the individuals exposed to foundation installation noise above the Level B harassment threshold which will be limited to temporary avoidance of small areas within the WDA for short periods of time; 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 6 sei whales expected to experience PTS (which meets the definition of harm in the context of the ESA definition of take), the only adverse effects to sei whales expected to result from the New England Wind project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment) of 58 individuals (49 due to exposure to foundation installation noise, 9 due to exposure to UXO detonations); we consider these adverse effects to occur at a level meeting NMFS's interim ESA definition of harassment. With the exception of the 6 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 37-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 New England Wind 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 for the New England Wind project 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 New England Wind 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 6 sei whales estimated to be exposed to impact 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 6 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 6 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 6 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 58 sei whales are expected to be exposed to foundation installation noise or UXO detonations (49 foundation installation, 9 UXO) 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 foundation installation noise or UXO detonations. However, even with these minimization measures in place, we expect 58 sei whales to experience TTS, temporary behavioral disturbance (approximately 4 hours but likely far shorter), and associated temporary physiological stress during the construction period due to exposure to foundation installation noise or UXO detonations. 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 58 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 exposure to noise from New England Wind 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 foundation installation noise). Also, as explained in section 7.1, we do not expect that avoidance of foundation installation 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 project 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 foundation installation noise may mask sei whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to foundation installation 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 foundation installation noise would only last for the duration of the exposure to foundation installation noise, approximately 4 hours per pile (with pile driving occurring for 4-16 hours per day), 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 58 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 foundation installation 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 foundation installation 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, a whale may swim up to 7 km to avoid noise above the behavioral harassment threshold. 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 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 New England Wind 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 New England Wind 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 New England Wind 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 sei 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 49 individuals exposed to foundation installation 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 New England Wind project are temporary behavioral disturbance and/or temporary threshold shift (minor and temporary hearing impairment) of up to 100 sperm whales that are exposed to foundation installation noise or UXO detonations above the Level B harassment threshold but below the Level A harassment threshold (inclusive of TTS and behavioral disturbance; 96 exposed to foundation installation noise and 4 exposed to UXO detonations); 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 37-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 New England project.

Based on the type of survey gear that will be deployed, any effects to sperm whales from the surveys of fishery resources planned for the New England Wind project 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 New England Wind 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. A number of sperm whales (no more than 100) are expected to be exposed to noise during foundation installation (drilling, impact, and vibratory pile driving) and UXO detonations 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 foundation installation noise or UXO detonations. 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 100 sperm whales to experience TTS, temporary behavioral disturbance and associated temporary physiological stress during the construction period due to exposure to foundation installation noise or UXO detonations (96 during foundation installation, 4 during UXO detonations). We have determined that the effects experienced by these 100 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 100 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 exposure to noise from the New England Wind 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 foundation installation noise). In addition, as explained in section 7.1, we do not expect that avoidance of foundation installation 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 project 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 foundation installation 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 foundation installation 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 foundation installation noise would only last for the duration of the exposure to foundation installation noise, which in all cases would be no more than approximately 4 hours at a time (with pile driving 4-16 hours a day) 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 foundation installation 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. 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 100 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 New England Wind 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 96 individuals exposed to foundation installation 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.

9.2.5 Blue Whales

As described in further detail in the Status of the Species, the most recent estimate indicated a global population of between 5,000 – 12,000 individuals globally (IWC 2007). Potential threats to blue whales identified in the 2020 Recovery Plan include ship strikes, entanglement in fishing gear and marine debris, anthropogenic noise, and loss of prey base due to climate and ecosystem change (NMFS 2020). There are no recent confirmed records of anthropogenic mortality or serious injury to blue whales in the U.S. Atlantic EEZ or in Atlantic Canadian waters (Henry et al. 2020). The total level of human caused mortality and serious injury is unknown, but it is believed to be insignificant and approaching a zero mortality and serious injury rate (Hayes et al. 2020). Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, the species has not recovered to pre-exploitation levels.

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 blue 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 blue 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, with the exception of 2 blue whales expected to experience PTS (which meets the definition of harm in the context of the ESA definition of take) the only adverse effects to blue whales expected to result from the New England Wind project are temporary behavioral disturbance and/or temporary threshold shift of up to 4 individuals due to exposure to noise from foundation installation (minor and temporary hearing impairment); these adverse effects meet NMFS interim ESA definition of harassment. With the exception of the 2 blue whales expected to experience PTS due to exposure to impact pile driving noise, no injury (auditory or other), or other) 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 blue whales overlaps with some parts of the vessel transit routes that will be used through the 37-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 blue 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 blue whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a blue whale and any associated injury or mortality is not an expected outcome of the New England Wind project.

Based on the type of survey gear that will be deployed, effects to blue whales from the surveys of fishery resources planned for the New England Wind project and considered as part of the proposed action are extremely unlikely to occur. As such, capture or entanglement of a blue whale and any associated injury or mortality is not an expected outcome of the New England Wind 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 blue whale prey. 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 blue 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 blue 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 2 blue whales estimated to be exposed to impact 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 2 blue 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 2 blue 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. These blue 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 4 blue whales are expected to be exposed to noise from foundation installation (drilling, impact and vibratory pile driving) 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 foundation installation noise or UXO detonations. However, even with these minimization measures in place, we expect 4 blue whales to experience TTS, temporary behavioral disturbance (approximately 4 hours but likely far shorter), and associated temporary physiological stress during the construction period due to exposure to foundation installation 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 4 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 the proposed foundation installation 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 blue 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 blue 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 foundation installation noise). Also, as explained in section 7.1, we do not expect that avoidance of this noise would result in blue 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 foundation installation 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 foundation installation noise may mask blue 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 this 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 foundation installation noise would only last for the duration of the exposure to the noise, which in all cases would be no more than approximately 4 hours. 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 blue whales in the WDA are migrating; opportunistic foraging may also occur. 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 4 blue whales exposed to harassing levels of noise will return to normal behavioral patterns after the exposure ends. As such, even if a blue whale exposed to foundation installation 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 foundation installation 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, a whale may swim up to 7 km to avoid noise above the behavioral harassment threshold. 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 detail in Section 7.1, we do not anticipate these instances of TTS and/or behavioral disturbance that meet the ESA harassment but not harm, to result in fitness consequences to the up to 4 blue 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 blue 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 blue 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 New England Wind project. Because we do not anticipate fitness consequences to individual blue 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 blue 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 blue 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 blue 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 blue whales in the action area or throughout their range.

The proposed action is not likely to affect the recovery potential of blue whales. In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2020 Recovery Plan for blue 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 two main objectives for blue whales identified in the 2020 Recovery Plan are to:

> 1) Increase blue whale resiliency and ensure geographic and ecological representation by achieving sufficient and viable populations in all ocean basins and in each recognized subspecies, and 2) increase blue whale resiliency by managing or eliminating significant anthropogenic threats. The Recovery Plan includes recovery criteria that address minimum abundance in each of the nine management units (abundance of 500 or 2,000 whales depending on the unit); stable or increasing trend in each of the nine management units; and criteria related to threat identification and minimization (NMFS 2020). The Recovery Plan also includes delisting criteria that address abundance, trends, and threat minimization/elimination (NMFS 2020).

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 blue whales.

The proposed action will not affect the abundance of blue whales; this is, because no mortality is anticipated, the project will not cause there to be fewer blue whales. The only effects to distribution of blue whales will be minor changes in the movements of up to 4 individuals exposed to foundation installation 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 blue 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 blue 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 blue 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 blue, 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 is not likely to adversely affect giant manta rays, hawksbill sea turtles, oceanic whitetip sharks, or critical habitat designated for the New York Bight DPS of Atlantic sturgeon. 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.

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, Park City Wind, LLC has applied for an MMPA ITA; a decision regarding issuance of the ITA is expected in 2024 following issuance of the Record of Decision for the project. Once a final authorization is issued, we will review this ITS to ensure it includes all measures necessary to comply with the authorization, and if necessary, make appropriate modifications.

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 as we consider those measures necessary and appropriate to minimize take but have not restated them here for efficiency. In order to monitor the impact of incidental take, BOEM, other action agencies, and Park City 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 installation to result in the harassment of an identified number of North Atlantic right, blue, 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 blue, fin and sei whales and NA DPS green, NWA DPS loggerhead, and leatherback sea turtles. We anticipate UXO detonation 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. 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 1 shortnose sturgeon and up to 1 Atlantic sturgeon from vessels transiting to/from the Paulsboro Marine 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 New England Wind 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 37-year life of the project, inclusive of construction, operations, and decommissioning of New England Wind Phase 1 and 2:

Species/DPS	**Vessel Strike**
	Mortality
Kemp's ridley sea turtle	2
Leatherback sea turtle	22
North Atlantic DPS green sea turtle	2
Northwest Atlantic DPS Loggerhead sea turtle	28

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, is anticipated as follows:

Port	**Species/DPS**	**Vessel Strike Mortality**
Paulsboro Marine Terminal	NYB DPS Atlantic Sturgeon	1
	Shortnose sturgeon	1

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 (six 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	73	None
Chesapeake Bay DPS Atlantic sturgeon	30	None
South Atlantic DPS Atlantic sturgeon	18	None
Carolina DPS Atlantic sturgeon	8	None
Kemp's ridley sea turtle	2*	None
Leatherback sea turtle	None	None
North Atlantic DPS green sea turtle	2*	None
Northwest Atlantic DPS Loggerhead sea turtle	2*	None

*No more than 2 takes, total, of any sea turtle species

No take of any species of ESA listed whale is anticipated or exempted for the proposed surveys. If any additional surveys are planned or the survey duration is extended, consultation may need to be reinitiated.

Foundation Installation (Vibratory and Impact Pile Driving and Drilling)
We calculated the number of whales and sea turtles expected to be harmed (Permanent Threshold Shift/acoustic injury) 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., 132 total foundations, meeting the isopleth distances identified for 10 dB attenuation). For ESA listed whales, this is consistent with the amount of Level A and Level B harassment from pile installation for foundations that NMFS OPR is proposing to authorize through the MMPA ITA.

Species/DPS	Take due to Exposure to Noise during Foundation Installation*	
	Harm/Injury (PTS)	Harassment (TTS/ Behavior)
Blue whale	2	4
Fin whale	33	352
North Atlantic right whale	None	74
Sei Whale	6	49
Sperm whale	None	96

*based on Construction Schedule B

Species/DPS	Take due to Exposure to Noise during Foundation Installation*			
	CONSTRUCTION SCHEDULE A		CONSTRUCTION SCHEDULE B	
	Harm/ Injury (PTS)	Harassment (TTS/ Behavior)	Harm/ Injury (PTS)	Harassment (TTS/ Behavior)
North Atlantic DPS green sea turtle	None	1	1	1
Kemp's ridley sea turtle	None	1	None	1
Leatherback sea turtle	2	6	5	6
Northwest Atlantic DPS Loggerhead sea turtle	1	7	2	10
Atlantic sturgeon – all five DPSs	None	None	None	None

UXO/MEC Detonation

We calculated the number of whales and sea turtles likely to be harmed (PTS/acoustic injury) or harassed (TTS and/or behavioral disturbance) due to exposure to UXO detonation based on the maximum impact scenario (i.e., 10 detonations, meeting the isopleth distances identified for 10 dB attenuation). The numbers below are the amount of take anticipated in consideration of 10 UXO detonations total. For ESA listed whales, this is consistent with the amount of Level A and Level B harassment from UXO detonation that NMFS OPR is proposing to authorize through the MMPA ITA.

Species	**UXO Detonation**	
	Harm/Injury (PTS)	**Harassment (TTS)**
Blue whale	None	None
Fin whale	None	16
North Atlantic right whale	None	27
Sei Whale	None	9
Sperm whale	None	4
Kemp's ridley sea turtle	None	None
Leatherback sea turtle	None	2
North Atlantic DPS green sea turtle	None	None
Northwest Atlantic DPS Loggerhead sea turtle	None	1
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 and, after review, NMFS determines the RPMs and terms and conditions in this ITS are consistent with the final mitigation measures in the ITA; 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 implementing 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. In addition to the minimization measures specified in Chapter 3, the he 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.

NMFS has determined that 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.

Please note that these reasonable and prudent measures and terms and conditions are in addition to the minimization and avoidance measures that Park City 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 minimization measures identified in Section 3 of this Opinion, including Appendix A and B, are considered part of the proposed action, many of which are necessary and appropriate to minimize take, 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; yet it is critical to minimizing take of North Atlantic right whale. 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.

We have determined that 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 WTG and ESP foundation installation.
2. Effects to ESA listed species must be minimized and monitored during UXO/MEC detonations.
3. Effects to ESA listed sturgeon resulting from project vessel operations in the Delaware Bay and Delaware River must be monitored and reported.
4. 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.
5. 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 any required concurrence.
6. 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 Park City (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 Park City fail to ensure compliance with these terms and conditions and the RPMs they implement, the protective coverage of Section 7(o)(2) may lapse. Note that throughout these Terms and Conditions we have identified a number of places where we direct reporting to BOEM, BSEE, USACE, and/or NMFS OPR in addition to NMFS GARFO. These additions have been made at the request of the action agencies; reporting to the action agencies in addition to NMFS GARFO aids in monitoring incidental take and monitoring implementation of these measures.

1. To implement the requirements of RPM 1 and 2, for ESA listed whales, Park City must comply with the measures specified in the proposed MMPA ITA (which are incorporated into the proposed action) as modified or supplemented in the final MMPA ITA, to minimize effects of foundation installation, UXO detonations, 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 Park City's Construction and Operations Plan for the New England Wind Project, Park City to comply with any measures for ESA-listed species 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 Park City 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 require, through an enforceable conditions of their individual permit authorizations, that Park City comply with any measures in the proposed MMPA ITA regarding ESA-listed marine mammals, which have already been incorporated into the proposed action, and as modified or supplemented by the final MMPA ITA.
2. To implement the requirements of RPM 1, the following measures related to sound field verification (SFV) for pile driving (inclusive of drilling) carried out for WTG and ESP foundation installation must be required by BOEM, BSEE, USACE, and implemented by Park City. The purpose of SFV and the steps outlined here are to ensure that Park City 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 as analyzed in the Opinion. These thresholds and the distances to them, 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 the initial pile driving methodology and sound attenuation measures (inclusive of impact pile driving, vibratory pile setting, and relief drilling) will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation; see Tables 7.1.10-7.1.13, 7.1.26, 7.1.27, 7.1.36)[53] 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

[53] As noted in section 7.1 of the Opinion, when these tables reference exposure ranges, Thorough SFV results will be compared to the appropriate corresponding distances calculated for acoustic ranges as reported in JASCO 2023.

expected to avoid exceeding those thresholds for the next pile being driven. In all instances, any reference to jacket foundation also covers pile driven bottom frame foundations should that alternative foundation type be installed in Phase 2. These requirements are only in place for pile driven foundations (i.e., they do not apply to suction bucket foundations).

a. BOEM, BSEE, and USACE must require, and Park City must develop a Sound Field Verification Plan, addressing Thorough and Abbreviated SFV, consistent with the requirements in T&C 13.d below. Thorough SFV consists of: SFV measurements 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 and three additional ranges selected such that measurement of identified isopleths are accurate, feasible, and avoid extrapolation. At least one additional measurement at an azimuth 90 degrees from the array at approximately 750 m must be made. At each measurement location, there must be a near-bottom and mid-water column hydrophone (measurement systems); the recordings must be continuous throughout the duration of all pile driving (inclusive of any relief drilling) of each foundation. Abbreviated SFV consists of: SFV measurements made at a single acoustic recorder, consisting of a near-bottom and mid-water hydrophone, at approximately 750 m from the pile, in the direction of lowest transmission loss, to record sounds throughout the duration of all pile driving (inclusive of relief drilling) of each foundation.

b. BOEM, BSEE, and USACE must require, and Park City must implement Thorough SFV, as detailed in 2c below, for at least the following foundations:

   - First construction year: the first 3 monopiles installed with only an impact hammer; the first 3 monopiles installed with a vibratory hammer followed by an impact hammer; the first 2 jacket foundations (all piles) installed; the first foundation (regardless of type) where relief drilling is used; the first monopile and first jacket foundation (all piles) installed in December (winter sound speed profile); and, the first foundation for any foundation scenarios that were modeled for the exposure analysis (e.g., rated hammer energy, number of strikes, representative location) that does not fall into one of the previously listed categories (e.g., if the first two jacket foundation are installed with an impact hammer only, Thorough SFV would be required for the first jacket foundation installed with vibratory and impact pile driving).

   - Any subsequent construction year:

      - if there are no changes to the pile driving equipment (i.e., same hammer, same Noise Attenuation System) – the first monopile and first jacket foundation (all piles);

      - if a revised FDR/FIR or other information is submitted to BOEM and BSEE that details changes to the equipment (e.g., different hammer, different noise attenuation system) – thorough SFV requirements for the first construction year apply.

- any foundation type or technique included in the requirements for the first construction year that was not installed until a subsequent construction year (e.g., if drilling is not used until year 2 or 3, the first foundation where relief drilling is used must have thorough SFV).

c. During Thorough SFV, installation of the next foundation (of the same type/foundation method) may not proceed until Park City has reviewed the initial results from the Thorough SFV and determined that there were no exceedances of any distances to the identified thresholds based on modeling assuming 10 dB attenuation.

d. If any of the Thorough 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, Park City must notify BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO within 24 hours of reviewing the Thorough SFV measurements and must implement the following measures for the next pile of the same type/installation methodology, as applicable. These requirements are in place for monopiles and jacket foundations and repeat until the criteria in 2.d.ii.a or 2.d.ii.b are met.

    i. <u>Clearance and Shutdown Zones.</u> If any of the Thorough 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 7.1.10-7.1.13, 7.1.26, 7.1.27, 7.1.36), the clearance and shutdown zones (see Table 11.1) for subsequent piles of the same type (e.g., if triggered by SFV results for a monopile, for the next monopile) must be increased so that they are at least the size of the distances to those thresholds as indicated by SFV. 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; Park City must deploy any additional PSOs consistent with the approved Pile Driving Monitoring Plan in consideration of the size of the new zones and the species that must be monitored (i.e., sea turtles and/or whales). Use of the expanded clearance and shutdown zones must continue for additional piles until Park City requests and receives concurrence from NMFS GARFO to revert to the original clearance and shutdown zones.

    ii. <u>Attenuation Measures.</u> Park City must identify one or more additional, modified, and/or alternative noise attenuation measure(s) and/or operational change(s) included in the approved SFV plan (see T&C 13d) that is expected to reduce sound levels to the modeled distances and must implement that measure for the next pile of the same type and pile driving method that is installed (e.g., if triggered by SFV results for a monopile installed with vibratory pile driving followed by impact pile driving, for the next monopile with vibratory pile driving followed by impact pile driving). Attenuation measures that could reduce sound levels to the modeled distances include but are not limited to adding a noise attenuation device, adjusting hammer operations, and adjusting or otherwise modifying the noise mitigation system. Park City must provide written notification to BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO of the changes implemented within 24 hours of their implementation.

a. If no additional, modified, and/or alternative measures or operational changes are identified for implementation, or if Thorough SFV of the third pile (of the same type and installation method; i.e., the pile installed with a second round of additional/modified noise attenuation or pile driving operations) indicates that the distance to any isopleths of concerns for any ESA listed species are still greater than those modeled assuming 10 dB attenuation, installation of that foundation type/installation methodology must be paused until there is concurrence from NMFS, BOEM, and BSEE to proceed. NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of the Thorough 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 Thorough 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. Implementation of additional measures to reduce noise and additional Thorough SFV may also be required as a result of this meeting.
b. Following installation of a pile with additional, alternative, or modified noise attenuation measures/operational changes required by 2.d if Thorough SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation, Thorough SFV must be conducted on two additional piles of

the same type/installation method (for a total of at least three piles with consistent noise attenuation measures). If the Thorough 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 Park City must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes. Park City can request concurrence from NMFS GARFO and NMFS OPR to return to the original clearance and shutdown zones (Table 11.1).

e. BOEM, BSEE, and USACE must require, and Park City must implement Abbreviated SFV for all piles for which the Thorough SFV monitoring outlined above is not carried out. Abbreviated SFV consists of: SFV measurements made at a single acoustic recorder, consisting of a near-bottom and mid-water hydrophone, at approximately 750 m from the pile, in the direction of lowest transmission loss, to record sounds throughout the duration of all pile driving (inclusive of relief drilling) of each foundation. The Abbreviated SFV data collected will be used to compare to the thresholds defined as a result of Thorough SFV to assess whether the representative levels at approximately 750 m were exceeded.

    i. Park City must review Abbreviated SFV results for each pile within 24 hours of completion of the foundation installation (inclusive of pile driving and any drilling), and, assuming measured levels at 750 m did not exceed the thresholds defined during Thorough SFV, does not need to take any additional action. Results of Abbreviated SFV must be submitted with the weekly pile driving report.
    ii. If measured levels from Abbreviated SFV for any pile are greater than expected levels, Park City must evaluate the available information from the pile installation to determine if there is an identifiable cause of the exceedance (i.e., a failure of the noise attenuation system), identify and implement corrective action, and report this information to BOEM, BSEE, USACE, and NMFS GARFO within 48 hours of completion of the installation of the pile (inclusive of all pile driving and drilling), during which the exceedance occurred. If Park City can demonstrate that the exceedance was the result of a failure of the noise attenuation system (e.g., loss of a generator supporting a bubble curtain such that one bubble curtain failed during pile driving) that can be remedied in a way that returns the noise attenuation system to pre-failure conditions, Park City can request concurrence from BOEM, BSEE, NMFS OPR, and NMFS GARFO to proceed without thorough SFV monitoring that would otherwise be required within 72 hours. Park City is required to remedy any such failure of the noise attenuation system prior to carrying out any additional pile driving.

iii. If results of Abbreviated SFV monitoring for any pile exceed expected values at 750 m, Park City must resume Thorough SFV monitoring (as described in 2a above) for installation of the same foundation type and installation method within 72 hours after the completion of the pile driving with an exceedance.

   i. Park City can request concurrence from BOEM, BSEE, NMFS OPR, and NMFS GARFO to resume Abbreviated SFV monitoring following submission of an interim report from Thorough SFV that demonstrates ranges to the identified thresholds within expected values. Park City may automatically resume Abbreviated SFV monitoring if three consecutive Thorough SFV reports indicate ranges to regulatory thresholds within predicted values. Interim Thorough SFV monitoring reports must be submitted to BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO within 48 hours of completion of the monitored pile.
   ii. If results from any Thorough SFV monitoring triggered by results from Abbreviated SFV indicate that ranges to the identified thresholds are larger than expected values, the requirements for Thorough SFV outlined in 2.a above apply (i.e., continuing Thorough SFV and implementing requirements for additional/modified attenuation measures). Additionally, BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO 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. Additional measures and Thorough SFV may also be required as a result of this meeting.

3. To implement the requirements of RPM 2, the following measures must be required by BOEM, BSEE, and/or USACE and implemented by Park City:

   a. Establish a clearance zone for sea turtles extending 500 m around any planned UXO/MEC detonations. Maintain the clearance zone for at least 60 minutes prior to any UXO/MEC detonation. This requirement clarifies the size of the clearance zone for sea turtles. Park City must ensure that there is sufficient PSO coverage to reliably document sea turtle presence within the clearance zone as described in the Marine Mammal and Sea Turtle Monitoring Plan (see T&C 13a). In the event that a PSO detects a sea turtle inside the 500 m clearance zone, detonation will be delayed until the sea turtle has not been observed for 30 minutes or has been observed to have left the clearance zone.

   b. Provide BOEM, BSEE, and NMFS GARFO with notification of planned UXO/MEC detonation as soon as possible but at least 48 hours prior to the planned detonation, unless this 48-hour notification would create delays to the detonation that would result in imminent risk of human life or safety. This notification must include the coordinates of the planned detonation, the estimated charge size, and any other information available on the characteristics of the UXO/MEC. NMFS GARFO will provide alerts to NMFS sea turtle and marine mammal stranding network partners consistent with best practices. Notification must be provided via email to nmfs.gar.incidental-take@noaa.gov and by phone to the NMFS GARFO Protected Resources Division (978-281-9328) and BSEE via TIMSWeb.

4. To implement the requirements of RPM 2, the following measures related to sound field verification (SFV) for UXO/MEC detonation must be required by BOEM, BSEE, USACE, and implemented by Park City. The purpose of SFV and the steps outlined here are to ensure that Park City does not exceed the distances to the injury (i.e., harm) or harassment thresholds for ESA listed marine mammals, the PTS or TTS thresholds for sea turtles, or the onset of injury thresholds for Atlantic sturgeon that are identified in this Opinion and that underpin the effects analysis, exposure analysis and our determination of the amount and extent of incidental take exempted in this ITS, including the determination that no incidental take is anticipated in some cases. The measures outlined here are based on the expectation that Park City's initial UXO/MEC detonation methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances to thresholds (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 the distances to those thresholds prior to the next planned detonation. The steps outlined here reflect the proposed action which considers a total of no more than ten detonations.

    a. Consistent with the measures incorporated into the proposed action, BOEM, BSEE, and USACE must require and Park City must implement thorough SFV for all UXO/MEC detonations (see also T&C 13.d. below) in accordance with the additional requirements specified here. If any of the SFV measurements from any detonation indicate that the distance to any isopleth of concern is greater than those modeled assuming 10 dB attenuation (see Tables 7.1.16, 7.1.17, 7.1.31, 7.1.32, 7.1.37), for the next detonation Park City must implement the following measures as applicable:

        i. Clearance Zones. Clearance zones must be increased to reflect the results of SFV. 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; Park City must deploy any additional PSOs consistent with the approved Pile Driving Monitoring Plan in consideration of the size of the new zones and the species that must be monitored (i.e., sea turtles and/or whales). Use of the expanded clearance and shutdown zones must continue for additional piles until Park City requests and receives concurrence from NMFS GARFO to revert to the original clearance and shutdown zones.

ii. Attenuation Measures: Park City must identify one or more additional, modified, and/or alternative noise attenuation measures or other change to the detonation plans (included in the SFV Plan) that is expected to reduce sound levels to the modeled distances. These measures must be implemented for the next detonation. Park City must provide written notification to BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO of the changes planned for the next detonation within 24 hours of implementation.

iii. If Park City determines that no additional measures or modifications are feasible for implementation following a UXO detonation where SFV measurements indicate that the distances to any identified isopleth of concern are greater than those modeled assuming 10 dB attenuation (see Tables 7.1.16, 7.1.17, 7.1.31, 7.1.32, 7.1.37), and NMFS, BOEM, BSEE, and USACE agree with that determination, 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. During that period, detonations must be delayed unless a delay would create an imminent risk to human life or safety.

5. To implement the requirements of RPMs 1 and 2, BOEM, BSEE, and/or USACE must require that Park City inspect and carry out appropriate maintenance on the noise attenuation system prior to every foundation installation event (i.e., for each pile driven foundation) and UXO detonation and prepare and submit a Noise Attenuation System (NAS) inspection/performance report to NMFS GARFO and NMFS OPR. 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 piles with Abbreviated SFV must be submitted with the weekly pile driving reports. For UXO detonations, the report must be submitted as soon as it is available, but no later than when the interim SFV report is submitted for the UXO detonation. All reports must be submitted by email to nmfs.gar.incidental-take@noaa.gov and submitted to BSEE through TIMSWeb.

   a. 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 or UXO detonation), 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 pile driving (inclusive of relief drilling), or UXO detonation.

6. To implement the requirements of RPM 3, the following conditions must be implemented:

    a. BOEM, BSEE, and/or USACE must require that Park City document and report project vessel trips to/from ports in the Delaware River, including the number of vessel calls to the Paulsboro Marine Terminal. This must be included in the monthly project reports submitted to NMFS GARFO over the life of the project (see T&C 9f. below). An annual summary of project vessel calls to Paulsboro 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 require that Park City implement 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 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 2023 Paulsboro Opinion.

7. To implement the requirements of RPM 4, BOEM, BSEE, and/or USACE must require that Park City prepare and submit interim and final SFV reports to NMFS GARFO (via email) and BSEE (via TIMSWeb) as outlined here:

    a. SFV Interim Reports - Foundation Installation and UXO/MEC detonation. BOEM, BSEE, and USACE must require Park City to provide the initial results of the SFV measurements to NMFS GARFO and NMFS OPR in an interim report as soon as it is available but no later than 48 hours after the installation of each pile for which thorough SFV is carried out and for UXO detonation, no later than 48 hours after the detonation. If technical or other issues prevent submission within

48 hours, Park City 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. 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.). 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 Park City to explain performance issues. Requirements for actions to be taken based on the results of the SFV are identified above.

b. In addition to the requirements above, all Thorough SFV reports for foundation installation must include a table with levels expected at 750 m for subsequent piles for which that thorough SFV is intended to represent (e.g., a 12 m monopile installed with a 6,000 kJ hammer with just impact driving), to be compared against measurements from Abbreviated SFV monitoring. Expected single strike metrics are the maxima of the 95th-percentile of measured unweighted SPL, SEL, and Peak. The expected cumulative metric of unweighted SEL for all impact pile-driving strikes must also be reported and compared. These tables must include the highest levels from Thorough SFVs for which isopleths were calculated to be within modeled ranges, assuming 10 dB attenuation rounded up to the next integer decibel, both actual measurements at 750 m, and fits based on measurements from recorders at other ranges. The highest levels in these tables, rounded to the next whole decibel, will be the “expected levels” to which Abbreviated SFV results must be compared.

c. All Abbreviated SFV reports must include the results from the hydrophones at 750m and a comparison to the expected levels at 750 m based on the previously completed thorough SFV for comparable pile type and installation method. Abbreviated SFV reports must be submitted with the weekly pile driving report.

d. SFV Final Reports - 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. The final results of Thorough SFV for UXO detonations must be submitted as soon as possible, but no later than within 90 days following completion of each UXO detonation. Within 60 days of the end of each construction season, Park City must compile and submit all final Abbreviated SFV reports.

8. To implement the requirements of RPM 4, BOEM, BSEE, and/or USACE must require that Park City 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 (vibratory or impact) or drilling. This report must be filed within 48 hours of the incident and include the following: description of the activity (i.e., drilling, vibratory or impact pile driving) and duration of pile driving or drilling 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).

9. To implement the requirements of RPM 4, BOEM, BSEE, USACE, must require Park City to implement the following reporting requirements necessary to document the amount or extent of incidental take that occurs during all phases of the proposed action. Unless otherwise specified all reports must be submitted to NMFS GARFO via e-mail (nmfs.gar.incidental-take@Noaa.gov) and BSEE via TIMSWeb.

    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 New England Wind 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. All sightings or acoustic detections of North Atlantic right whales must be reported immediately (no later than 24 hours). PAM detections and sightings of right whales with no visible injuries or entanglement must be reported as described in (i) below. Reporting requirements for suspected vessel strikes and injured/dead right whales are in (c) and (d) below.

        i. If a NARW is sighted with no visible injuries or entanglement or is detected via PAM at any time by project PSOs/PAM Operators or project personnel, Park City must immediately report the sighting or acoustic detection to NMFS; if immediate reporting is not possible, the report must be submitted as soon as possible but no later than 24 hours after the initial sighting or acoustic detection.

- To report the sighting or acoustic detection, download and complete the Real-Time North Atlantic Right Whale Reporting Template spreadsheet found here: https://www.fisheries.noaa.gov/resource/document/template-datasheet-real-time-north-atlantic-right-whale-acoustic-and-visual. Save the spreadsheet as a .csv file and email it to NMFS NEFSC-PSD (ne.rw.survey@noaa.gov), NMFS GARFO-PRD (nmfs.gar.incidental-take@noaa.gov), and NMFS OPR (PR.ITP.MonitoringReports@noaa.gov).
- If unable to report a sighting through the spreadsheet within 24 hours, call the relevant regional hotline (Greater Atlantic Region [Maine through Virginia] Hotline 866-755-6622; Southeast Hotline 877-WHALE-HELP) with the observation information provided below (PAM detections are not reported to the Hotline).
- Observation information: Report the following information: the time (note time format), date (MM/DD/YYYY), location (latitude/longitude in decimal degrees; coordinate system used) of the observation, number of whales, animal description/certainty of observation (follow up with photos/video if taken), reporter's contact information, and lease area number/project name, PSO/personnel name who made the observation, and PSO provider company (if applicable) (PAM detections are not reported to the Hotline).
- If unable to report via the template or the regional hotline, enter the sighting via the WhaleAlert app (http://www.whalealert.org/). If this is not possible, report the sighting to the U.S. Coast Guard via channel 16. The report to the Coast Guard must include the same information as would be reported to the Hotline (see above). PAM detections are not reported to WhaleAlert or the U.S. Coast Guard.

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, Park City must immediately report the incident to NMFS (at the phone numbers and email addresses identified below) and BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Reports to NMFS must be made by phone and email:

- Phone: If in the Greater Atlantic Region (ME-VA): the NMFS Greater Atlantic Stranding Hotline (866-755-6622); in the Southeast Region (NC-FL): the NMFS Southeast Stranding Hotline (877-942-5343).
- Email: 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 any PSO or other project personnel, including any project vessel operator or crew, observe or identify a stranded, entangled, injured, or dead ESA listed species (e.g. marine mammal, sea turtle, listed fish), Park City must immediately report the observation to NMFS (by phone (marine mammals and turtles only) and email (marine mammal, sea turtle, listed fish) and BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov):

   - Phone: If in the Greater Atlantic Region (ME-VA):e NMFS Greater Atlantic Stranding Hotline (866-755-6622); in the Southeast Region (NC-FL) call the NMFS Southeast Stranding Hotline (877-942-5343). Note, the stranding hotline may request the report be sent to the local stranding network response team.
   - Email: 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). . 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. Park City must compile and submit weekly reports during each month that foundation installation occurs that document: the foundation/pile ID, type of pile, pile diameter, start and finish time of each drilling and 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. The weekly reports must also confirm that the required SFV was carried out for each pile and that results were reviewed on the required timelines. Abbreviated SFV reports must be appended to the weekly report. These weekly reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE by Park City 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), Park City 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, including transits from all ports, foreign and domestic)), cable installation activities (including sea to shore transition), number of foundations installed and pile IDs, UXO detonation, and all sightings/detections of ESA listed whales, sea turtles, and sturgeon. Sightings/detections must include species ID, time, date, initial detection distance, vessel/platform name, vessel activity, vessel speed, bearing to animal, project activity, and any mitigation measures taken as a result of those observations. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (TIMSWeb and protectedspecies@bsee.gov) and are due on the 15th of the month for the previous month.

g. Park City 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 and BSEE must require Park City to 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 the completion of foundation installation and UXO detonations have ended for the calendar year (i.e., if the last foundation of construction year 1 is installed on November 30, the report is due by March 1 of the following year). 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 and BSEE, must require Park City to 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 via email.

10. To implement the requirements of RPM 4 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.

11. To implement the requirements of RPM 4, within 10 business days of BOEM, BSEE, and/or USACE obtaining updated information on project plans (e.g., 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 and electrical service platforms for each project; 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, confirmation of location of O&M facility) that will be used by project vessels. This information may be provided in separate submissions for Project 1 and Project 2. NMFS

GARFO will review this information and, to the maximum extent practicable, within 10 business days of receipt will 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.

12. To implement RPM 4 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 Park City or their contractors will deploy non-NEFOP trained survey personnel in lieu of NEFOP-trained observers, BOEM, BSEE, and/or Park City 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 Park City must obtain NMFS GARFO's concurrence with this observer training plan prior to the deployment of the non-NEFOP trained observer on any 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.

13. To implement RPM 5, BOEM, BSEE, and/or USACE must require, and Park City must prepare and submit the plans identified below in sufficient time to allow for review and any required approval prior to the planned start date for the associated activities. All plans must be submitted to NMFS GARFO at nmfs.gar.incidental-take@noaa.gov as well as to BOEM (renewable_reporting@boem.gov), BSEE (via TIMSWeb with a notification email to protectedspecies@bsee.gov), and USACE (cenae-r-@usace.army.mil).

- 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.
- Within 60 days of issuance of this Biological Opinion, Park City must schedule a meeting with NMFS GARFO to: review the plan requirements, discuss the review/approval process, and develop a schedule for when plans can be expected to be submitted for review.
- Between 30 and 90 days before the planned start of foundation installation each year, Park City must meet with NMFS GARFO, BOEM, BSEE, USACE, and NMFS OPR

to review the construction plans and schedule for the upcoming construction season, and review requirements for reporting and notification protocols, and Thorough and Abbreviated SFV requirements.

- All plans must be submitted at least 180 days in advance of the planned start of relevant activities (e.g., the foundation installation monitoring plan must be submitted at least 180 days before the planned date for installation of the first pile). For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and Park City, 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 complete and is determined to be consistent with the identified requirements, NMFS GARFO will provide concurrence with the plan. If the plan is determined to be inconsistent with these requirements (e.g., if required information is missing), Park City must resubmit a modified plan that addresses the identified issues within 30 days of the receipt of the comments. For all subsequent drafts, Park City must provide for at least 10 day calendar days for review and comment.
    a. Marine Mammal and Sea Turtle Monitoring Plan – Foundation Installation and UXO/MEC detonation. BOEM, BSEE, and/or Park City must submit this Plan (or Plans if separate plans are prepared for foundation installation and UXO/MEC detonation) to NMFS GARFO at least 180 calendar days before the respective activity is planned to begin (i.e., if foundation installation or UXO detonation is planned for May 1, the plan must be submitted no later than November 1 of the preceding year). BOEM, BSEE, and Park City must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any drilling or pile driving for foundation installation and before any UXO/MEC detonation.

        - 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 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 foundation installation events and UXO/MEC detonations.
        - 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 including any expansion of clearance and/or shutdown zones that may be required as a result of SFV.
        - The Plan(s) must contain a thorough description of how Park City will monitor foundation installation activities (drilling, vibratory and impact pile driving) during reduced visibility conditions (e.g. rain, fog) and in other low

visibility conditions, 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 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.

- The Plan must contain a thorough description of how Park City will monitor foundation installation 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.
- The plan must describe how Park City would determine the number of sea turtles exposed to noise above the 175 dB harassment threshold during foundation installation and how Park City would determine the number of ESA listed whales exposed to noise above the Level B harassment threshold during foundation installation and UXO detonation (in consideration of modeling that indicates that distances to the level B harassment threshold may extend beyond the clearance and shutdown zones being monitored by PSOs).

b. Nighttime Monitoring Plan – Foundation Installation. BOEM, BSEE, and/or Park City must submit this Plan to NMFS GARFO at least 180 calendar days before foundation installation is planned to begin. This plan can be included as a sub-section of the Marine Mammal and Sea Turtle Monitoring Plan addressed above or as a stand-alone plan. This Plan(s) must contain a thorough description of how Park City will monitor foundation installation activities (drilling, vibratory and impact pile driving) 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 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 and jacket foundations before and during foundation installation (drilling, vibratory and impact pile driving), nighttime foundation installation may not occur; the only exception would be if safety necessitates continuing pile installation after dark for a foundation that was initiated 1.5 hours prior to civil sunset, in which case the Low Visibility components of the Pile Driving Monitoring Plan would be implemented.

c. Passive Acoustic Monitoring Plan for Pile Driving and UXO/MEC Detonation. BOEM, BSEE, and/or Park City must submit this Plan to NMFS GARFO at least 180 calendar days before either Pile Driving or UXO/MEC detonation 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 Park City must obtain NMFS GARFO's concurrence with this Plan prior to the start of any foundation installation or UXO/MEC Detonation. 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 T&C 9.
d. Sound Field Verification Plan - Foundation Installation and UXO/MEC detonation. BOEM, BSEE, and USACE must require Park City to submit this Plan (or Plans if separate Foundation Installation and UXO/MEC plans are prepared) to NMFS GARFO at least 180 calendar days before pile driving for foundations and UXO/MEC detonation is planned to begin. BOEM, BSEE, and Park City must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of foundation installation and UXO detonations. The Plan must detail all plans and procedures for sound attenuation, including procedures for adjusting and optimizing the noise attenuation system(s), maintenance procedures and timelines, and detail the available contingency noise attenuation measures/systems if distances to modeled isopleths of concern are exceeded (as documented during SFV).

    i. Foundation Installation: The plan must describe how Park City will conduct the required Thorough SFV (T&C 1a) for each of the required foundation types, installation methodologies, and locations. In the case that the foundation sites planned for Thorough SFV are determined to not be representative of all other foundation installation sites for a scenario, Park City must include information on how additional sites will be selected for Thorough SFV. Park City must provide justification for why these locations are representative of the scenario modeled. The plan must describe how Park City will conduct the required Abbreviated SFV, inclusive of requirements to review results within 24 hours and triggers for Thorough SFV. The Plan must provide a table of the identification number and coordinates of each foundation location, and specify the underwater acoustics analysis model scenario against which each foundation location's SFV results will be compared. The Plan(s) must also include the piling schedule and sequence of events, communication and reporting protocols, and methodology for collecting, analyzing, and preparing SFV data for submission to NMFS, including instrument deployment, locations of all hydrophones (including direction and distance from the pile), hydrophone sensitivity, recorder/measurement layout, and analysis methods. The Plan must also identify the number and distance of relative location of hydrophones for Thorough and Abbreviated SFV. The plan must include a template of the interim report to be submitted and describe the all the information that will be reported in the SFV Interim Reports including the number, location, depth, distance, and predicted and actual isopleth distances that will be included in the final report(s). The Plan must describe how the interim SFV report results will be evaluated against the modeled results, including which modeled scenario the results will be reported against, and include a decision tree of what happens if measured values exceed predicted values. The Plan must address how Park City will implement the measures associated with the required SFV which includes, but is not limited to, identifying additional or modified noise attenuation measures (e.g., additional noise attenuation device, adjust hammer operations, adjust or modify the noise mitigation system) that will be applied to reduce sound levels if measured distances are greater than those modeled as well as implementation of any expanded clearance or shutdown zones, including deployment of additional PSOs.

ii. UXO Detonation: The plan must describe how Park City will conduct the required Thorough SFV for all planned UXO detonations (T&C 4). Thorough SFV consists of: SFV measurements made at a minimum of four distances from the detonation, 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 and three additional ranges selected such that measurement of identified isopleths are accurate, feasible, and avoid extrapolation. At least one additional measurement at an azimuth 90 degrees from the array at approximately 750 m must be made. At each location, there must be a near bottom and mid-water column hydrophone (measurement systems). The Plan must describe how the interim SFV report results will be evaluated against the modeled results and decision tree of what happens if measured values exceed predicted values. The Plan must address how Park City will implement the measures associated with the required SFV which includes, but is not limited to, identifying additional or modified noise attenuation measures (e.g., additional noise attenuation device, adjust hammer operations, adjust or modify the noise mitigation system) that will be applied to reduce sound levels if measured distances are greater than those modeled as well as implementation of any expanded clearance or shutdown zones, including deployment of additional PSOs.

e. Vessel Strike Avoidance Plan. Park City must submit this plan to NMFS GARFO as soon as possible after issuance of this Biological Opinion but no later than 180 days prior to the planned mobilization of any vessels operated by or under contract to Park City for the New England Wind project (i.e., any vessel associated with construction, operations and maintenance, or decommissioning activities described in this Opinion). The Plan must include: an acknowledgement of the vessels that are subject to the plan; all relevant mitigation and monitoring measures for listed species inclusive of a summary of all applicable vessel speed and approach 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, darkness, and in consideration of the use of artificial lighting. NMFS GARFO will review this plan and identify any inconsistencies with the requirements for vessel strike avoidance required by regulation or otherwise incorporated into the proposed action considered in the Biological Opinion. With the exception noted below, NMFS GARFO's concurrence with this plan is not required prior to vessel mobilization.

    i. If Park City plans to implement PAM in any transit corridor to allow vessel transit above 10 knots, Park City must prepare a plan (a standalone plan or supplement to the Vessel Strike Avoidance Plan) that describes: the location of each transit corridor (with a map); how PAM, in combination with visual observations, will be conducted to ensure highly effective monitoring for the presence of right whales in the transit corridor; and, the protocols that will be in place for vessel speed restrictions following detection of a right whale via PAM or visual observation. This plan must be provided to NMFS GARFO for review at least 180 days in advance of planned deployment of the PAM system. PAM information should follow what is required to be submitted for the PAM Plan in T&C 13.c. BOEM, BSEE, and Park City must receive NMFS GARFO's concurrence with this plan prior to implementation of the PAM-monitored transit corridor.

14. To implement the requirements of RPM 6, 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 Park City 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.

15. To implement the requirements of RPM 6, Park City 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.

16. To implement the requirements of RPM 6, Park City, 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. Neither the lessee nor any action agency may interfere with any reporting to NMFS by a PSO or other personnel of any identified or suspected non-compliance with any such measures or any identified or suspected incidental take.

Table 11.1. Clearance and Shutdown Zones for ESA Listed Species - Pile Driving and UXO/MEC detonations

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 by NMFS OPR during the consultation period, 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. UXO/MEC detonation will not proceed unless the entirety of the clearance zone is visible to the PSOs. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving or UXO/MEC detonation; detection of an animal in the shutdown zone triggers the identified shutdown requirements. Further modification of the minimum visibility, clearance, and/or shutdown zones for marine mammals may be included in the final MMPA ITA; in which case this requirement would be amended to require compliance with the final minimum visibility, clearance, and/or shutdown zones to the extent that modified zones are more protective.

Species	Clearance Zone (m)	Shutdown Zone (m)
Monopile Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 2,100 m monopile; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At	At any distance (Minimum visibility zone (2.1km for monopiles) plus any additional distance observable by the visual PSOs on all PSO platforms); At

	any distance within the 12 km zone monitored by PAM	any distance within the 12 km zone monitored by PAM
Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	3,300 m (visual or PAM detection)	2,700 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)
Jacket Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): 3,400 m jacket foundations; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (3.4 km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM	At any distance (Minimum visibility zone (3.4km) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 12 km zone monitored by PAM
Blue, Fin, sei, and sperm whale (visual and PAM monitoring)	4,900 m (visual or PAM detection)	4,100 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)
UXO Detonations – Entirety of clearance zone must be visible; PAM monitoring out to 12,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance observable by the visual PSOs on all PSO platforms; At any distance within the 12 km zone monitored by PAM	***N/A***
Blue, Fin, sei whale (visual and PAM monitoring)	2,500-10,000 m*	***N/A***
Sperm whale	500-2,000 m*	***N/A***
Sea Turtles	500 m	***N/A***

*The clearance zones, which are visually and acoustically monitored, for UXO/MEC detonations were derived based on an approximate proportion of the size of the Level B harassment (TTS) isopleth. The clearance zone sizes are contingent on Park City being able to demonstrate that they can identify charge weights in the field; if they cannot identify the charge weight sizes in the field then PCW would need to assume the E12 charge weight size for all detonations and must implement the E12 clearance zone.

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, blue, 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 and 5
The proposed action incorporates requirements for Thorough and Abbreviated 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 Thorough 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*[54]. This measure was developed in close coordination with BOEM, BSEE, and NMFS OPR. 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, Thorough 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 Abbreviated 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 Park City 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 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. Term and

[54] https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEMOffshoreWindPileDrivingSoundModelingGuidance.pdf; last accessed December 1, 2023.

Condition 5 is necessary and appropriate to require the implementation of maintenance of the noise attenuation system; this is expected to be necessary to ensure proper function which is necessary to achieve the required attenuation.

RPM 2 /Term and Condition 3, 4, and 5
During the consultation period, the clearance zones for sea turtles during pile driving and UXO detonation were revised by BOEM. The measure included in Term and Condition 2 clarifies the size of the clearance zone during all UXO detonations, regardless of charge size, as 500 m. The size of the clearance zone minimizes the risk that a sea turtle just outside the clearance zone would enter the area where noise would be above the PTS threshold before the detonation occurred. Given the extensive PSO coverage, including aerial coverage, that will be required during UXO detonations, and the requirement that detonation can occur during daylight only when visibility is excellent, we expect that this larger area will be able to be effectively monitored. Implementation of this measure will serve to minimize take. Term and Condition 3b requires NMFS to be notified 48-hours in advance of any planned detonation. This notification will allow us to alert NMFS sea turtle and marine mammal stranding network partners, consistent with best practices, who can then be on alert for any reports of injured or distressed animals, which will assist in monitoring the effects of the detonations. This measure includes a clause for reduced notification period if a 48-hour delay would result in imminent risk of human life or safety. Term and Condition 3 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. Term and Condition 5 is necessary and appropriate to require the implementation of maintenance of the noise attenuation system; this is expected to be necessary to ensure proper function which is necessary to achieve the required attenuation.

RPM 3 /Term and Condition 6
As explained above, take that may occur of Atlantic and shortnose sturgeon as a result of vessel strike is expected to occur from New England Wind project vessels transiting in the Delaware River/Bay as they move to/from the Paulsboro Marine Terminal. In this Opinion, we have identified the portion of the take identified in the Paulsboro Biological Opinion that will be attributable to New England Wind project vessels. That take is exempted through the Incidental Take Statement issued with NMFS' Biological Opinions for the Paulsboro project. Here, we identify the relevant RPMs and Terms and Conditions from the Paulsboro ITS that must be complied with in order for the relevant take exemption included in the Paulsboro Opinion to apply.

RPM 4/Term and Conditions 7, 8, 9, and 12
Documenting the effects of project activities and any 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 7, 8, 10, and 12 enhance or clarify those requirements. Reporting of SFV results is necessary to monitor the effects of foundation installation and UXO detonation. 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 4/Term and Condition 10

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 Park City 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 5/Term and Condition 11

Term and Condition 11 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 Park City 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 pile driven 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 5/Term and Condition 13

A number of plans are proposed for development and submission by Park City 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 6/Term and Condition 14-16
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 Park City's 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 Park City 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 16 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 and UXO detonation in May and December.
2. Collect data to add to the limited information we have on underwater noise generated during operations of the direct drive wind turbines in the action area.
    i. 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 New England Wind 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 deployment and maintenance of a receiver array in the New England Wind WDA and surrounding waters
10. Support research regarding the abundance and distribution of Atlantic sturgeon in the New England WiInd 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 New England Wind 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 New England 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 New England Wind 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

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30 CFR 285.910(a). Reorganizations of Title 30-Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf. January 31, 2023.

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This concludes formal consultation for the proposed authorizations associated listed herein for the New England Wind 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.

APPENDIX A

Mitigation, Monitoring, and Reporting Measures Considered Part of the Proposed Action As Described in the BA and Committed to by the Applicant and Proposed or Modified by the Bureau of Ocean Energy Management (Table 15 in BOEM's December 2023 BA)

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
All Activities – All Stages		
Mitigation measures align with ITA and other permit conditions	The applicant will adhere to any additional requirements for the Proposed Action set forth by MMPA and ESA consultations, as well as BOEM PDCs/BMPs, and Record of Decision conditions.	The measures required by the final MMPA ITA would be incorporated by reference where appropriate into COP approval, and BOEM and/or BSEE would monitor compliance with these measures. These conditions may include foundation installation, foundation drilling, UXO, survey activity, and vessel operation under the period of the ITAs that may be issued.
PSO/PAM training and qualifications	The applicant will use NMFS-approved PSOs to monitor clearance and shutdown zones during foundation installation and HRG survey activity, as well as any UXO detonation.	BOEM will require that the applicant comply with applicant-proposed measures, and • PSOs must meet these minimum qualifications: o Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target; o Ability to conduct field observations and collect data according to assigned protocols; o Experience or training in the field identification of marine mammals, including the identification of behaviors; o Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations; o Writing skills sufficient to document observations including, but not limited to: the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone; and marine mammal behavior; and • Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.
General PSO measures	PSOs must not exceed 4 consecutive watch hours on duty at any time, must have a 2-hour	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.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	(minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period.	***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. • 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.
	PSOs will use visual aids (e.g., range finders, binoculars, night vision devices, infrared/thermal camera) when necessary. PSOs will have no tasks other than to conduct observations,	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	collect and report data, and communicate with and instruct relevant vessel crew regarding the presence of marine mammals and mitigation requirements.	
	For all activities, monitoring distances will be measured with range finders or reticle binoculars. Distances to marine mammals observed will be based on the best estimate of the PSO, relative to known distances to objects in the vicinity of the PSO. Bearings to animals must be determined using a compass.	
	PSOs must record all incidents of marine mammal and sea turtle occurrence, regardless of distance from the construction activity.	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	During all observation periods related to pile-driving activities, PSOs will use high-magnification (25X), standard handheld (7X) binoculars, and the naked eye to search continuously for marine mammals. During periods of low visibility (e.g., darkness, rain, fog, etc.), PSOs will use alternative technology (e.g., infrared/thermal camera) to monitor shutdown and clearance zones.	
Project training	All proposed Project personnel working offshore will receive standardized environmental awareness training, which will stress individual responsibility for marine mammal and marine debris awareness and reporting. Prior to commencing offshore	BOEM will require that the applicant comply with applicant-proposed measures and • Ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to a lease 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 at marinedebris@bsee.gov. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities must 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 must include the following elements: o Viewing of either a video or slide show by the personnel specified above; o An explanation from management personnel that emphasizes their commitment to the requirements; o Attendance measures (initial and annual); and o Recordkeeping and the availability of records for inspection by the Department of the Interior (DOI). • By January 31 of each year, the Lessee must submit to DOI an annual report signed by the Lessee that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. Reports must be

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure

	activities associated with either construction or HRG surveys, team members will participate in induction meetings, where summary materials are presented in person and with video materials covering topics including the following:
	• Code of Business Conduct including environmental commitments;
	• Relevant regulatory statutes, laws, and permit requirements;
	• Specific conditions and procedures related to offshore activities (e.g., marine debris protocols, marine mammal monitoring and mitigation, spill reporting);
	• Protected
		sent via email to renewable_reporting@boem.gov and to marinedebris@bsee.gov
		• All PSOs must have completed a training program with BOEM-approved PSO training materials. PSOs must also have received NMFS approval to act as a PSO for geophysical surveys. The Lessee must provide to BOEM upon request, documentation of NMFS approval as PSOs for geophysical activities in the Atlantic and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80% or greater. Instructions and application requirements to become a NMFS- approved PSO can be found at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/protected-species-observers.
		• For situations where Trained Lookouts are used when PSOs are not required, training must include protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
		• The Lessee must ensure a PSO or crew lookout is posted during all times to avoid interactions with ESA-listed species when a vessel is underway (transiting or surveying) by monitoring 180 degrees in the forward path of the vessel.
		  o Visual observers monitoring the vessel separation distances from ESA listed species can be either PSOs or crew members (if PSOs are not required). If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility on shift. Any designated crew lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
		  o Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.
		• Vessels underway must not divert their course to approach any ESA-listed species and marine mammals.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	species and trained crew observers' procedures for sighting, reporting, and protection of species including vessel strike avoidance and sound source management; • Protected species identification; and • Communication protocols. All personnel are required to register their participation in the induction training. These records are auditable. Additional refresher training related to the protected species monitoring and mitigation plan is provided offshore, and individuals joining the proposed Project who did not attend the initial induction training will be required to	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	participate in a separate training session, with their participation recorded for the proposed Project. Environmental management plans will be created for construction operations and HRG surveys. The environmental management plan includes all of the induction training components, including full copies of relevant permits and permit-required plans, protected species identification materials, communication flow charts and contact information. These materials are all retained in accessible areas on all proposed Project vessels.	
Data Collection Programmatic 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; https://media.fisheries.noaa.gov/2021-12/OSW-surveys-NLAA-programmatic-rev-1-2021-09-30-508-.pdf) shall be applied to activities associated with the construction, maintenance and operations of the New England Wind project as applicable.
Marine debris	—	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

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
reduction and awareness training		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).
NARW monitoring and reporting	The applicant will report NARW (*Eubalaena glacialis*) observations to NMFS Office of Protected Resources within 24 hours. The applicant will monitor NMFS NARW reporting systems from November 1 through July 31and whenever a DMA is established within any areas vessels operate. During these times, personnel will check the NMFS' NARW	BOEM will require that the applicant comply with applicant-proposed measures and • The Lessee must ensure all vessel operators check for information regarding mandatory or voluntary ship strike avoidance (SMAs and DMAs, or Slow Zones that are also designated as DMAs) and daily information regarding North Atlantic right whale sighting locations. These media may include, but are not limited to: NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, the Whale Alert app, or WhaleMap website. o North Atlantic right whale Sighting Advisory System info can be accessed at: https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html o Information about active SMAs, DMAs, and Slow Zones can be accessed at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales o Vessels operating in water depths with less than 4 ft. clearance between the vessel and the bottom should maintain speeds no greater than 4 knots to minimize vessel strike risk to sturgeon and sawfish.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	reporting systems on a daily basis.	
Vessel strike avoidance policy	The proposed Project will implement a vessel strike avoidance policy for all vessels under contract to the applicant to reduce the risk of vessel strikes, as well as the likelihood of death and/or serious injury to ESA-listed marine mammals, sea turtles, or marine fish that may result from collisions with vessels. As safe and practicable, the applicant will adhere to NOAA guidelines for vessel strike avoidance during all proposed Project activities, including vessel speed restrictions and separation distances, that are applicable at the time of construction and during HRG surveys. All NMFS speed restrictions with respect to	BOEM will require that the applicant comply with applicant-proposed measures and New England Wind must 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 (as determined in the MMPA ITR or RPMs of the biological opinion). BOEM will also require that a vessel plan be submitted for review by BOEM and NMFS Office of Protected Resources 120 days prior to start of construction. The vessel plan will detail all speed and vessel strike avoidance measures employed during all stages of the proposed Project for all vessel types, including any adaptive speed plans, NARW strike avoidance measures, and compliance monitoring methods. Additionally, any vessels transiting from ports outside the United States will be required to have a trained lookout on board who will start monitoring when the vessel enters U.S. waters.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	NARW will be followed. Vessel operators and crew will maintain a vigilant watch for marine mammals and slow down or maneuver their vessels, as appropriate, to avoid a potential interaction with a marine mammal.	
Vessel separation distances	Vessel separation distances are as follows: • NARW: 1,640 feet (500 meters) • All other whales (includes ESA-listed whales and unidentified whales): 328 feet (100 meters) • Dolphins, porpoises, seals, sea turtles: 164 feet (50 meters)	BOEM will require that the applicant comply with applicant-proposed measures and 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 1,640 feet (500 meters) 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 656 feet (200 meters) 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 1,640 feet (500 meters). If stationary, the vessel must not engage engines until the large whale has moved beyond 1,640 feet (500 meters).
Vessel speed restrictions	The applicant will adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to	BOEM will require that the applicant comply with applicant-proposed measures and • Vessel captain and crew must maintain a vigilant watch for all protected species and reduce speed, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any listed species. The presence of a single individual at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. If pinnipeds or small delphinids of the following genera: *Delphinus*, *Lagenorhynchus*, *Stenella*, and *Tursiops* are visually detected approaching the vessel (i.e., to bow ride) or towed equipment, vessel speed reduction, course alteration, and shutdown are not required. • To monitor the minimum separation distance, a PSO (or Trained Lookout if PSOs are not

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	reduce the risk of impact on NARWs as a result of proposed Project activities in the SWDA. During appropriate time periods and within certain areas, proposed Project-related vessels traveling to/from Salem Harbor will transit at 11.4 miles per hour (18.4 kilometers per hour; 10 knots) or less within NOAA-designated NARW critical habitat and outside critical habitat.	required) must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). o Visual observers monitoring the minimum separation distance can be either PSOs or Trained Lookouts (if PSOs are not required). If the Trained Lookout is a vessel crew member, this must be their designated role and primary responsibility on shift. Any crew designated as Trained Lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements. o Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures. o Vessels underway must not divert their course to approach any ESA-listed species and marine mammals. • Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA) and Dynamic Management Area (DMA) or Slow Zone triggered by visual detections of North Atlantic right whales. An exception to this requirement is for vessels operating in areas within portions of a visually designated DMA or Slow Zone where it is not reasonable to expect the presence of North Atlantic right whales (e.g., Long Island Sound, shallow harbors). • BOEM encourages increased vigilance through the required best management practices to minimize vessel interactions with protected species, by reducing speeds to 10 knots or less when operating within an acoustically triggered slow zone, and when feasible, avoid operating in or transiting through Slow Zones. • BOEM and the USACE will also ensure all vessels follow the most recent NOAA guidelines regarding vessel speed restrictions to minimize vessel interactions with protected species. Furthermore, the applicant must comply with the vessel strike avoidance and vessel speed restriction measures. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements.
Lookout for sea turtles and reporting	—	BOEM will require that the applicant comply with the following sea turtle measures: • For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, New England Wind 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. • For all vessels operating south of the Virginia/North Carolina border, year-round, New England Wind 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. • 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. • The trained lookout would maintain a vigilant watch and monitor a 500-m Vessel Strike Avoidance Zone at all times to avoid 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

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
		minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. • 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. • 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. • 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 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. • 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. • 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. • 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.
Foundation Installation – Construction		
Pile driving monitoring plan	—	BOEM would ensure that New England Wind 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 New England Wind 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. New England Wind would obtain NMFS' concurrence with this plan prior to starting any pile driving.
Time of year restrictions	The applicant expects to establish a restriction on pile-driving activities (i.e., impact pile driving, vibratory driving, and	—

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	drilling) between January 1 and April 30. There is no seasonal restriction applied to HRG surveys and potential detonation of UXO.*[NMFS Note: A time of year restriction is imposed by the MMPA ITA]	
Time of day restrictions	For the ESP post-piled jackets, piling will be initiated during daylight hours (no later than 1.5 hours prior to civil sunset) and need to continue until all piles are installed to maintain asset integrity at the sea floor and to alleviate health and safety concerns. If up to three ESP jackets require nighttime piling, breaks between piles will be limited to the shortest duration possible, noise abatement systems will be used, and PAM systems will be	BOEM will require additional measures for nighttime piling (to be described within the Alternative Monitoring Plan and PAM Plan), and BOEM will require noise abatement systems and PAM systems for all foundation installation. The applicant will also submit two monitoring plans for NMFS and BOEM review and approval 6 months prior to initiating impact pile-driving activities: • Low visibility pile driving monitoring plan • Nighttime pile driving monitoring plan The purpose of these plans is to demonstrate that the applicant can meet the visual monitoring criteria for the Level A harassment zone(s)/mitigation and monitoring zones plus an agreed upon buffer zone (these combined zones are referred to henceforth as the nighttime and low visibility clearance and shutdown zones). Both monitoring plans will demonstrate effective use of technologies that the applicant is proposing to use for monitoring during nighttime and during daytime low visibility conditions for instances when lighting or weather (e.g., fog, rain, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. “Daytime” is defined as one hour after civil sunrise to 1.5 hours before civil sunset. Visual monitoring criteria will be developed by NMFS and BOEM and detailed in the Final EIS. the low visibility pile driving monitoring plan will be applicable during pile-driving activities conducted in poor or low visibility conditions (i.e., instances where clearance and shutdown zones cannot be effectively visually monitored), hereafter termed low visibility pile driving. The low visibility pile driving monitoring plan will also be applicable during times when a pile was started during daylight, including all pre-start clearance and soft-start protocols, but for unforeseen reasons, piling had to continue after civil twilight. If any part of the pre-start clearance and/or soft-start protocols associated with pile driving are conducted after civil twilight, the nighttime pile driving monitoring measures will be required. If during low visibility pile driving, undetected animals are found in the clearance and/or shutdown zones, low visibility impact pile-driving activities will cease as soon as possible in consideration of human safety, and NMFS, BOEM, and BSEE will be notified immediately. The low visibility pile driving monitoring plan will need to contain the following components: • Identification of low visibility monitoring devices (e.g., vessel-mounted thermal infrared camera systems, handheld or wearable night vision devices, handheld infrared imagers) that will be used to detect marine mammal and sea turtle species relative to the established clearance and shutdown zones; • The buffer zone distance and total clearance and shutdown zones; and

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	deployed.	• A description of the monitoring methods, detection reliability, communication protocols, reporting and decision-making protocols that will be used during low visibility conditions.
PSO monitoring	PSOs must visually monitor to a minimum radius around monopile and jacket foundations equivalent to the calculated impact pile-driving exposure range to Level B harassment thresholds using NMFS' unweighted 160 dB SPL or as modified based on sound field verification.	BOEM will require that the applicant comply with a modified PSO monitoring measure: PSOs must visually monitor all waters within visual range, including waters beyond the 160 dB isopleth (Level B harassment thresholds using NMFS unweighted 160 dB SPL), around monopile and jacket foundations. The entire extent of the clearance zone (modeled or adjusted after measurements) must be visible for visual monitoring to begin.
Sound field verification measurement plan	A sound field verification measurement plan will be submitted to NMFS for review and approval at least 90 days prior to the planned start of pile driving. The plan will follow the framework laid out in Appendix C of the draft ITA application and include underwater sound measurements during foundation installation to confirm that	New England Wind 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. BOEM and USACE would ensure that sound field monitoring occurs as deemed appropriate in consultation with NMFS. Clearance and/or shutdown zones may be required to be expanded due to the verification of sound fields from Project activities and PSO coverage expanded to ensure sufficient coverage 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.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	the sound propagation predicted by hydroacoustic modeling is comparable to, or lower than, measured sound in the field. Such confirmation will help demonstrate that estimated exposures of marine mammals and sea turtles were appropriately predicted.	
RSLL	—	BOEM intends to develop a second RSLL aimed at reducing Level B Harassment (e.g., potential to disrupt important behaviors), especially for LFCs. Although the application of the Level A LFC RSLL also reduces Level B zones to some extent, more Level B reduction may be required to meet MMPA negligible impact determinations, especially in areas of higher presence of low population species like NARWs. BOEM will advise the applicant once a second RSLL is developed to consider implementation concerns, if any.
Level A and B harassment distance verification for foundation installation	The applicant will conduct field verifications of actual impact and vibratory pile driving during installation of the WTG foundations for model validation purposes and to further determine the effectiveness of the mitigation measures employed. Measurements will be performed either by extrapolating from in-situ	—

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	measurements conducted at several points from the pile being driven or by direct measurements to locate the distance where the received levels reach the relevant Level A harassment and Level B harassment thresholds.	
Adaptive management of sound field verification measurements	If needed, based on the sound field verification-informed distances to Level A and Level B harassment thresholds, the adaptive refinement of clearance zones, shutdown zones, and monitoring and mitigation measures (either a decrease or an increase) will be agreed upon with the federal agencies.	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 no less than the PTS distance 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.
	If the initial sound field verification measurements indicate distances to the isopleths corresponding to Level A harassment	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	and Level B harassment thresholds are greater than the predicted distances (based on modeling assuming 10 dB attenuation), the applicant will implement additional sound attenuation measures prior to conducting additional pile driving (e.g., improving the efficacy of the implemented noise attenuation technology, adjusting the piling schedule to reduce the sound source).	
	If these corrective actions do not result in achieving the predicted zones, the applicant will install an additional noise attenuation system to achieve the modeled ranges and/or deploy additional observation tools. Each sequential modification	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	will be evaluated empirically by sound field verification.	
	If sound field verification measurements continue to indicate distances to isopleths corresponding to Level A and Level B harassment thresholds are consistently larger than those predicted by modeling, the applicant may request that NMFS expand the relevant clearance and shutdown zones and associated monitoring measures.	
Noise mitigation / abatement systems	The proposed Project will use a noise mitigation system for all impact piling events for foundation installation. The noise mitigation system methods have not been finalized at this stage; however, the applicant expects to implement noise attenuation	BOEM will require that the applicant comply with applicant-proposed measures and • The lessee should implement the best-available sound attenuation technology that would be targeted at reducing foundation installation noise, to maximum extent practicable with a minimum target of 10 dB reduction from unattenuated pile driving noise. • The lessee should have a second back-up attenuation device (e.g., bubble curtain or similar) available, if needed, to achieve the targeted reduction in noise levels, pending results of sound field verification testing. • If the lessee uses a bubble curtain, the bubble curtain must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact. The lessee must require that construction contractors train personnel in the proper balancing of airflow to the bubblers and would require that construction contractors submit an inspection/performance report for approval by the lessee following the performance test. Corrections to the attenuation device to meet the performance standards would occur prior to impact driving

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	mitigation to reduce sound levels by a target of approximately 12 dB or greater. The applicant will use two noise attenuation systems during pile driving (two bubble curtains: one bubble curtain and one AdBm encapsulated bubble sleeve, etc.) for monopile installation and up to two noise attenuation systems for jacket installation. The proposed Project will also use noise abatement systems for all UXO detonation events and is committed to achieving a minimum of 10 dB of attenuation.	
PAM plan and general PAM monitoring	PAM will occur during all foundation installation activities and supplement the visual monitoring program.	BOEM and USACE would ensure that New England Wind 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.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	A PAM plan will be submitted to NMFS and BOEM for review and approval at least 90 days prior to the planned start of pile driving. The plan must describe all proposed PAM equipment, procedures, and protocols.	
	The plan will include a description of the PAM hardware and software used for marine mammal monitoring, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, and limitations of the equipment, and other information.	
	PAM PSOs will operate in shifts under the same conditions as visual PSOs. PAM will be conducted by at least one	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	dedicated PAM PSO. The PAM PSO(s) will have completed specialized training for operating the PAM system.	
	The dedicated PAM PSO must acoustically monitor to a minimum radius of 39,370 feet (12,000 meters) around monopile foundations and jacket foundations during foundation installation and drilling activities.	
	PAM will begin 60 minutes prior to the initiation of the soft start, throughout foundation installation, or installation, and for 30 minutes after pile driving has been completed.	
	The dedicated PAM PSO will inform the lead PSO on duty of animal detections approaching	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	or within applicable mitigation zones.	
Visual monitoring for foundation pile driving	During pile-driving activities (i.e., impact pile driving, vibratory pile setting, and drilling), a single, dedicated PSO vessel will be used for visual monitoring. A minimum of two PSOs will be on active duty from 60 minutes before, during, and for 30 minutes after all pile installation activity. The dedicated PSO vessel will be located at the best vantage point to observe and document ESA-listed species in proximity to the clearance and/or shutdown zones.	BOEM will require that the applicant comply with applicant-proposed measures and the following: • In order to commence pile driving at foundations, PSOs must be able to visually monitor the exclusion zone radius from their observation points for at least 60 minutes immediately prior to piling commencement. Acceptable visibility will be determined by the Lead PSO and documented in PSO reports. • During pile-driving activities (i.e., impact pile driving, vibratory pile setting, and drilling), visual monitoring will be conducted from the construction/installation platform and two additional dedicated PSO vessels. If clearance zones are reduced after sound field verification measurements and consultation, a reduction in the number of PSO vessels can be proposed. A 4,921-foot (1,500-meter) increase in any marine mammal clearance zone or 1,640-foot (500-meter) increase in the sea turtle clearance zone will require an additional dedicated PSO vessel or the applicant must demonstrate other methods for effective visual monitoring of marine mammals and sea turtles in the expanded zones. Demonstration of this coverage should be provided in pile driving monitoring plan for review.
Clearance and shutdown zones for foundation installation and drilling	The clearance and shutdown zones for proposed Project foundation installation and drilling activities presented below for	BOEM will require that the applicant comply with applicant-proposed measures and: BOEM and USACE would ensure that New England Wind monitors the distance where noise would exceed the 175 dB re 1 µPa behavioral disturbance 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.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	monopile and jacket foundations separately (summarized from JASCO 2023 and Appendix III-M; Epsilon 2023).*[NMFS NOTE – to reduce confusion, the table has been removed here, please refer to the table in section 3 of the Opinion which reflects the consolidated clearance and shutdown zones that are part of the proposed action]	
Clearance for pile driving of foundations	The PSOs will implement a 60-minute clearance period of the clearance zones prior to impact pile driving for the foundations. If any marine mammal or sea turtle is detected within the applicable clearance zone during the soft start, activities will be delayed until the animal is observed leaving the	BOEM will require that the applicant comply with applicant-proposed measures and: The PSOs will implement a 60-minute clearance period of the clearance zones prior to any pile driving or pile drilling for the foundations.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	clearance zone or until 30 minutes have passed without a detection of the animal within the clearance zone.	
Species noise exposure reporting for vibratory pile driving of foundations	Due to the size of the zones, visual monitoring of the Level B zones for drilling and vibratory setting is not planned. To account for the potential presence of marine mammals within the Level B zone, the ensonified area between the mitigation zones and Level B harassment threshold will be multiplied by the density estimate appropriate for each species for each activity and rounded to the nearest integer to calculate assumed take for those species beyond the mitigation zones for purposes of reporting.	—

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
Visual monitoring during nighttime and periods of reduced visibility for pile driving of foundations	During periods of low visibility (e.g., darkness, rain, fog, etc.), PSOs will use alternative technology (e.g., infrared/thermal camera) to monitor shutdown and clearance zones.	BOEM will require that the applicant comply with applicant-proposed measures and the Alternative Monitoring Plan conditions described below.
	All PSOs on duty will be in contact with the on-duty PAM operator who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.	
Shutdowns for foundation pile driving	If a marine mammal or sea turtle is detected entering or within the respective shutdown zones after impact pile driving has commenced, an immediate shutdown of pile driving will be implemented when practicable as determined by the lead engineer on duty who will determine if a shutdown is	BOEM will require that the applicant comply with applicant-proposed measures and: BOEM and the USACE may consider reductions in the shutdown zones for sei, fin, or sperm whales based upon sound field verification of a minimum of three piles; however, BOEM/the USACE will ensure that the shutdown zone for sei, fin, blue, and sperm whales is not reduced to less than 3,281 feet (1,000 meters), or 1,640 feet (500 meters) for sea turtles. No reductions in the clearance or shutdown zones for NARW will be considered regardless of the results of sound field verification of a minimum of three piles. If a NARW is detected within the modeled PTS $ER_{95\%}$ during piling, an immediate shutdown of all piling activities will be implemented and a review of the monitoring and mitigation procedures will be conducted for the proposed Project, in consultation with NMFS and BOEM, before piling may resume.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	safe and practicable.	
	If shutdown is called for but determined that shutdown is not feasible due to risk of injury or loss of life, there will be a reduction of hammer energy if feasible.	
	Following shutdown, pile driving will only be initiated once the animal has been observed exiting its respective shutdown zone within 30 minutes of the shutdown, or if an additional time period has elapsed with no further sightings (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammal species, and 30 minutes for sea turtles).	
	The shutdown zone will be continually monitored by PSOs and PAM	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	operators during any pauses in pile driving.	
	If pile driving shuts down for reasons other than mitigation (e.g., mechanical difficulty) for periods less than 30 minutes, pile driving may restart without ramp-up if PSOs have maintained constant observations and no detections of any marine mammal or sea turtle have occurred.	
Ramp-up (soft start) for impact pile driving	Each impact pile installation will begin with a minimum of 20-minute soft-start procedure.	BOEM will require that the applicant comply with applicant-proposed measures and • The lessee must implement soft start techniques for pile driving. For impact pile driving, the soft start must include a minimum of 20 minutes of 4-6 strikes/min at 10-20 percent of the maximum hammer energy. • Soft start is required at the beginning of driving a new pile and at any time following the cessation of impact pile driving for 30 minutes or longer.
	Soft-start procedure will not begin until the clearance zone has been cleared by the visual PSOs and PAM operators, as applicable.	
	If a marine mammal is detected within or about to enter the applicable	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	shutdown zone, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been observed exiting the shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammal species, and 60 minutes for sea turtles).	
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 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. 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

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
		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 New England Wind's 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.
UXO Detonations – Construction, Operations		
Visual monitoring during UXO detonations (vessel based)	Two PSOs will visually survey the UXO clearance zone at least 60 minutes prior to a detonation event, during the event, and for 30 minutes after the event.	BOEM will require that the applicant comply with a modified visual monitoring measure for UXO detonations: Two PSO vessels, each with two PSOs on watch, will visually monitor the UXO clearance zone at least 60 minutes prior to a detonation event, during the event, and for 30 minutes after the event.
Time of day restrictions	No UXO will be detonated during nighttime hours.	—
	Only one detonation may occur in a 24-hour period.	
PAM during UXO detonations	PAM will be conducted during UXO detonations.	BOEM will require that the applicant comply with applicant-proposed measures and for UXO detonations, the dedicated PAM PSO must acoustically monitor to a minimum radius of 8.8 miles (14,100 meters) around the detonation site.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	PAM will begin at least 60 minutes prior to UXO detonation and extend at least 30 minutes after the event.	
Clearance for UXO detonations	A 60-minute clearance period will be implemented prior to any in-situ UXO detonation.	—
	The clearance zone must be fully visible for at least 30 minutes prior to commencing detonation.	
	All marine mammals must be confirmed to be out of the clearance zone prior to initiating detonation.	
	If a marine mammal is observed entering or within the relevant clearance zones prior to the initiation of detonation, the detonation must be delayed.	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	The detonation may commence when either the marine mammal(s) has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or when 30 minutes have elapsed without redetection for whales, including the NARW, or 15 minutes have elapsed without redetection of dolphins, porpoises, and seals.	
UXO clearance zones	The clearance zones for UXO detonation are provided below (JASCO 2023).*[NMFS Note – see table in section 3 of the Biological Opinion]	BOEM will require that the applicant comply with applicant-proposed measures and BOEM will require that a 500 m sea turtle clearance zone will be established. *[NMFS Note – distance updated during the consultation period]
Noise attenuation for UXO detonations	The applicant will use a noise mitigation system for all detonation events and is	—

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	committed to achieving the modeled ranges associated with 10 dB of noise attenuation.	
HRG Surveys – Construction, Operations		
PDC and BMP for HRG Survey Activities	—	BOEM will require New England Wind to comply with all the Project Design Criteria and Best Management Practices for Protected Species that implement the integrated requirements for threatened and endangered species in the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021 (https://media.fisheries.noaa.gov/2021-12/OSW-surveys-NLAA-programmatic-rev-1-2021-09-30-508-.pdf).
Visual monitoring for HRG surveys	Visual monitoring of the established HRG clearance and shutdown zones will occur around regulated active acoustic sources (CHIRP sub-bottom profilers, boomer or sparker sources).	BOEM will require that the applicant comply with applicant-proposed measures and • For situational awareness of marine mammals and ESA-listed species that may be in the survey area, during times third-party protected species observers (PSOs) are on duty, they must monitor to the farthest extent practicable, with a primary focus being 200 m around geophysical survey vessels (i.e., the Clearance Zone). At all times PSOs are on duty, any observed species must be recorded. • For all protected species, Clearance Zones of 200 m for all ESA-listed species of marine mammal must be clear of all animals for 30 minutes before ramp-up or any deployed survey equipment is activated. • PSOs deployed for mitigation, monitoring, and reporting of geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks other than to conduct observational effort, record data, communicate with and instruct relevant vessel crew to the presence of listed species and implement required PDCs and BMPs. PSOs on duty must be clearly listed on daily data logs for each shift. o Non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs • A minimum of one PSO must be observing for listed species on each vessel at all times that noise-producing equipment is operating, or the survey vessel is actively transiting. The Lessee must include a PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not work for more than 12 hours in any 24-hour period. • Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for maximum possible 360-degree field of view around the sound source and vessel. If 360-degree field of view is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage to ensure both geophysical survey and vessel strike avoidance requirements for ESA-listed species can be implemented. • Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner. • Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., • 7 x 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
		listed species located in proximity to the Clearance and Shutdown Zone(s). • Digital cameras with a telephoto lens that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR). The camera or lens should also have an image stabilization system. Used to record sightings and verify species identification when possible. • A laptop or tablet to collect and record data electronically. • Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality. • PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity. • Any other tools deemed necessary to adequately perform PSO tasks.
	During daylight hours, one PSO will be on duty.	
	During periods of low visibility (e.g., darkness, rain, fog, etc.), PSOs will use alternative technology (e.g., infrared/thermal camera) to monitor shutdown and clearance zones.	
Clearance and shutdown zones for HRG surveys	The following clearance/ shutdown zones will be implemented during HRG surveys: • Clearance and shutdown zones will be implemented at any distance for detections of NARW • 12,467-foot (3,800-meter) clearance and shutdown	--

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	zone for all ESA-listed marine mammal species (except NARW); • 3280-foot (1,000-meter) shutdown zone for all other marine mammals; except seals and delphinids from the genera Delphinus,and Lagenorhynchus, Stenella or Tursiops; and • 656-foot (200-meter) clearance and shutdown zone for sea turtles.	
Clearance for HRG surveys	Clearance zones will be monitored for all marine mammal and sea turtle species for 30 minutes before any CHIRP sub-bottom profilers, boomer, or sparker sources are initiated.	--
	If any marine mammal or sea turtle is observed within the applicable clearance zone during the 30-minute	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	clearance period, ramp-up will not begin until the animal(s) is/are observed exiting the clearance zones or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for small odontocetes, seals and sea turtles; and 30 minutes for all other species).	
Ramp-up for HRG surveys	Where technically feasible, HRG equipment will be activated starting with the lowest practical power output appropriate for the survey and then gradually turned up and other sources added in such a way that the source level increases gradually.	BOEM will require that the applicant comply with applicant-proposed measures and Ramp up of the boomer or sparker survey equipment must occur at the start or re-start of geophysical survey activities when technically feasible. A ramp up must begin with the power for the geophysical survey equipment ramped up half power for 5 minutes, and then to full power.
Shutdowns for HRG surveys	An immediate shutdown of HRG survey equipment specified in the incidental harassment authorization permit will be required if a	--

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	marine mammal or sea turtle is detected at or within its respective shutdown zone.	
	If another marine mammal or sea turtle enters a shutdown zone during the shutdown period, the HRG equipment may not restart until that animal is confirmed outside the respective exclusion or until the appropriate time has passed from the last sighting of the marine mammal.	
Fisheries Surveys – All Stages		
General mitigation and monitoring measures during fisheries surveys	Vessel operators and crew will maintain a vigilant watch for marine mammals and adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to	BOEM will require that the applicant comply with applicant-proposed measures and • Ensure 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. • 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. • 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 New England Wind prepares a training plan that addresses how this requirement would be met and that the plan is submitted to NMFS in

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	reduce the risk of impact on NARWs and other marine mammals. Vessel distances from a marine mammal will adhere to federal guidelines for species-specific separation distances. Vessels will maintain a separation distance and exclusion zone that are applicable at the time of the surveys (currently 1,640 feet [500 meters] for NARW, 328 feet [100 meters] for other whale species, and 164 feet [50 meters] for dolphins, porpoises, and seals from the vessel and associated fishing gear). In the event a marine mammal is sighted near a vessel in transit, the captain will remain parallel to the animal, slow down, or maneuver their vessel, as appropriate, to	advance of any trawl or trap surveys. This requirement is in place for any trips where gear is set or hauled. • 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. o The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed (https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). o 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). o 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). ▪ 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. ▪ 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. o 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. • 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 those handling and resuscitating the animal(s) to do so. Specifically: o 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. o 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-

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	avoid a potential interaction with a marine mammal. Vessels will follow NMFS guidelines for vessel strike avoidance that are applicable at the time of the surveys by maintaining required separation distances from the animal, which will be monitored by trained vessel operators and crews. Vessel operators will check the NMFS' NARW reporting systems on a daily basis. Additionally, it is expected that vessel captains will monitor USCG VHF Channel 16 throughout the day to receive notifications of any sightings. This information will be used to alert the team to the presence of a NARW in the area and implement mitigation measures as appropriate. Whenever	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. o 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. o 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). o 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. o 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

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	multiple proposed Project vessels are operating, all sightings of listed species will be communicated between vessels. Vessel operators and crew will monitor for marine mammals prior to deployment of fishing gear (e.g., trawl net) and continue to monitor until the gear is brought back on deck. If a marine mammal is sighted within 1 nautical mile (1.9 kilometers, 1.15 miles) of the survey vessel within 15 minutes prior to the deployment of the research gear and it is considered to be at risk of interaction with the gear, the sampling station will be suspended until there are no sightings of marine mammals for at least 15 minutes within 1 nautical mile	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	(1.9 kilometers, 1.15 miles) of the sampling station. The vessel operator may also relocate the vessel away from the marine mammal to a different sampling location.	
Reporting and sampling for incidental take during fisheries surveys	If any protected species are captured, they should be immediately released, and the incident should be reported in accordance with protected species reporting requirements to NMFS and BOEM. All trawl survey activities will comply with relevant take reduction plan regulations.	BOEM will require that the applicant comply with applicant-proposed measures and • Should any interactions with ESA-listed species occur, the contracted scientists will follow the sampling protocols described for at-sea monitors (ASMs in Fisheries Sampling Branch Observer On-Deck Reference Guide 2016 (Northeast Fisheries Science Center [NEFSC] 2016). Protected species interactions will be reported immediately to NOAA's stranding hotline via telephone (866-755-NOAA) or via the Whale Alert App, and a written report will be provided to the NMFS GARFO (incidental.take@noaa.gov) within 24 hours, as detailed in the FRMP. The following protocol will also be followed: o Should lethal incidental take of a marine mammal occur, the entire animal will be retained if practicable and provided to NOAA. If the animal cannot be retained, the contract scientists will complete the minimum ASM sampling requirements. o Should incidental take of Atlantic sturgeon occur, the contracted scientists will follow the sampling protocols described for the Northeast Fisheries Observer Program in the reference guide (NEFSC 2016), as follows: ▪ Live sturgeon will be released after scanning the animal for a passive integrated transponder tag; ▪ All data and any biological samples resulting from sturgeon encounters will be provided to the NEFSC
Demersal otter trawl survey	Marine mammal monitoring will be conducted by the captain and/or a survey crew member before deployment, during survey activities, and upon retrieval of fishing gear. Vessel	--

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	operators and fisheries survey personnel working offshore will receive environmental training, including marine mammal species identification. At least one of the survey staff onboard will have completed training (within past 5 years) in protected species identification and safe handling. Trawl tows will be limited to a 20-minute trawl time at 3.0 knots. If marine mammals are sighted before the gear is fully removed from the water, the vessel will slow its speed and maneuver the vessel away from the animals to minimize potential interactions with the observed animal. If a marine mammal is observed within 1	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	nautical mile (1.9 kilometers, 1.15 miles) of the planned sampling station in the 15 minutes prior to gear deployment, the applicant will delay setting the trawl until the marine mammal has not been observed for 15 minutes. The applicant may also relocate the vessel away from the marine mammal to a different sampling location. If marine mammals are still visible from the vessel after relocation, the applicant may decide to relocate again or move on to the next sampling station. If marine mammals are sighted before the gear is fully removed from the water, the vessel will slow its speed and maneuver the vessel away from the animals to	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	minimize potential interactions with the observed animal. The vessel crew will open the cod end of the trawl net close to the deck to avoid injury to animals that may be caught in the gear. Gear will be emptied immediately after retrieval within the vicinity of the deck. Trawl nets will be fully cleared and repaired if damaged before redeployment. Unless human safety will be compromised, there will be reasonable efforts made to recover lost gear within 24 hours. If the gear cannot be retrieved in 24 hours, the gear will be retrieved as soon as it is safe. All lost gear will be reported to the U.S. Department of the Interior in compliance with BOEM and BSEE's	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	incident reporting requirements and procedures. In addition to lost gear, all lost or discarded marine trash and debris will be reported to U.S. Department of the Interior in compliance with BOEM and BSEE's requirements and reporting procedures found in the applicant's lease or grant and/or the BOEM 2021 BMPs. BOEM will share this information with NMFS.	
Trap/pot/gillnet surveys	To avoid entanglement with vertical lines, buoy lines will be weighted and will not float at the surface of the water, and all groundlines will consist of sinking line. Downlines of each string will use weak link or ropeless technology to deter whale entanglements. All gear will be compliant with the	BOEM will require that the applicant comply with applicant-proposed measures and 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. 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/20283).

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	Atlantic large whale take reduction plan. Adequate gear for disentanglement (i.e., knife and boathook) will be onboard all survey vessels. Buoy lines and linkages will be compliant with best practices. “Ropeless” gear may be tested and used. All buoys will be properly labeled with the scientific permit number and identification as research gear. All labels and markings on the buoys and buoy lines will be compliant with the applicable regulations, and all buoy markings will comply with instructions received by the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division.	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	Any lost fishing gear will be immediately reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division. In the event that any marine mammal or sea turtle is entangled in survey gear, the NMFS stranding hotline will be contacted immediately.	
Mooring Systems – All Stages		
Buoy deployment, operations, and retrieval	—	BOEM will require New England Wind to comply with all the Project Design Criteria and Best Management Practices for Protected Species that implement the integrated requirements for threatened and endangered species in the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021 (https://media.fisheries.noaa.gov/2021-12/OSW-surveys-NLAA-programmatic-rev-1-2021-09-30-508-.pdf).
Dredging – Construction, Operations		
Dredging activities outside of cable installation operations	—	BOEM will require that the applicant: • Implement USACE standard PSO requirements for suction/hydraulic dredges if used in areas where ESA-listed marine fish or sea turtles may occur. • Use silt retainment curtains if feasible. • When applicable and practicable, apply time of year restrictions for nearshore dredging and silt-producing activities associated operations facility improvements that occur in areas where ESA-listed marine fish or sea turtles may occur.
Reporting – All Stages		

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
All activities	The applicant will submit annual reports as required under the MMPA ITA. The applicant will compile and submit weekly PSO and PAM reports to NMFS (at PR.ITP.monitoring reports@noaa.gov) that document the daily start and stop of all pile-driving activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals, any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise attenuation system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday through	BOEM will require that the applicant comply with applicant-proposed measures and BOEM will also ensure that the applicant implements the following reporting requirements necessary to document the amount or extent of take that occurs during all stages of the proposed Project: • All reports would be sent to: nmfs.gar.incidental-take@noaa.gov. • During the construction phase and for the first year of operations, New England Wind 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. • Beginning in Year 2 of operations, New England Wind 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.

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	Saturday).	
Injured protected species reporting	The applicant will report impacts on marine mammals to jurisdictional/interested agencies, including NOAA and BOEM, as required.	BOEM will require that the applicant comply with applicant-proposed measures and • Regardless of survey type or the need to provide a dedicated trained watch stander or PSO, any potential take, strikes, or dead/injured protected species caused by Project activities must be reported to the NMFS GARFO Protected Resources Division nmfs.gar.incidental-take@noaa.gov), NOAA Fisheries 24-hour Stranding Hotline – for marine mammals from Maine-Virginia, report to (866) 755-6622, and from North Carolina-Florida to (877) 942-5343 and for sea turtles from Maine-Virginia, report to (866) 755-6622, and from North Caroline-Florida to (844)732-8785.BOEM (at mailto: renewable_reporting@boem.gov), and BSEE (at mailto:) as soon as practicable, but no later than 24 hours from the time the incident took place (Protected Species Incident Report). The Protected Species Incident Report must include the following information:protectedspecies@bsee.gov) as soon as practicable, but no later than 24 hours from the time the incident took place (Protected Species Incident Report). The Protected Species Incident Report must include the following information: o Contact info for the person providing the report; o Time, date, and location (latitude/longitude) of the incident; o Species identification (if known) or description of the animal(s) involved; o Condition of the animal(s) (e.g., live, injured, dead); o Observed behaviors of the animal(s), if alive; o If available, photographs or video footage of the animal(s); and o General circumstances (e.g. vessel speed/direction of travel, sound sources in use) under which the animal was impacted • All dead or injured protected species, must be reported regardless of whether they were observed during operations or directly due to Lessee activities. In the event that an injured or dead marine mammal or sea turtle is sighted, regardless of the cause, the Lessee must report the incident to the NMFS Protected Resources Division (nmfs.gar.incidental-take@noaa.gov), NMFS 24-hour Stranding Hotline number (866-755-6622), BOEM (at renewable_reporting@boem.gov), and BSEE (at protectedspecies@bsee.gov) as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours from the sighting (Dead or Injured Protected Species Report). Staff responding to the hotline call will provide any instructions for the handling or disposing of any injured or dead protected species by individuals authorized to collect, possess, and transport sea turtles. The Protected Species Incident Report must include the following information: o Time, date, and location (latitude/longitude) of the first discovery (and updated

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
		location information if known and applicable); o Species identification (if known) or description of the animal(s) involved; o Condition of the animal(s) (including carcass condition if the animal is dead); o Observed behaviors of the animal(s), if alive; o If available, photographs or video footage of the animal(s); and o General circumstances under which the animal was discovered • If a live or dead marine protected species becomes entangled, operators must immediately contact the applicable stranding network coordinator using the reporting contact details and provide any on-water assistance requested.
	If a NARW is involved in any incidents, the vessel captain or PSO onboard should also notify the Right Whale Sighting Advisory System hotline as soon as practicable, but no later than 24 hours after the event.	
Reporting observed impacts on species	PSOs/PAM operators will report any observations concerning impacts on ESA-listed marine mammals, sea turtles, and marine fish to NMFS within 48 hours.	BOEM will require that the applicant comply with applicant-proposed measures and the measures proposed previously under "Injured protected species reporting"
	BOEM and NMFS will be notified within 24 hours if any evidence of a fish kill during construction activity is observed.	

Measure	Applicant-Proposed Measure	BOEM-Proposed Measure
	For all pile-driving activities, PSOs will document any behavioral reactions in concert with distance from the pile being driven.	
BOEM/NMFS meeting requirements for sea turtle take documentation	—	To facilitate monitoring of the incidental take exemption for 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.
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 annually. Survey design and effort (i.e., the number of WTGs and frequency of reporting) may be modified only upon concurrence by BOEM and BSEE and based upon review of annual reports. 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 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.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; COP = Construction and Operations Plan; dB = decibel; dB re 1 μPa = decibels referenced to 1 micropascal; dB re 1 μPa^2 = decibels referenced to 1 micropascal squared; dB re 1 μPa2 s = decibels referenced to 1 micropascal squared second; DMA = dynamic management area; EIS = Environmental Impact Statement; $ER_{95\%}$ = 95th percentile exposure range; ESA = Endangered Species Act; ESP = electrical service platform; GARFO = Greater Atlantic Regional Fisheries Office; HRG = high-resolution geophysical; ITA = incidental take authorization; kJ = kilojoule; LFC = low-frequency cetacean; MFC = MFC = mid-frequency cetacean; MMPA = Marine Mammal Protection Act; NARW = North Atlantic right whale; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; PAM = passive acoustic monitoring; PDC = Project Design Criteria; PDE = Project design envelope; PPW = phocid pinniped in water; PSO = protected species observer; PTS = permanent threshold shift; RSLL = received sound level limit; SEL = sound exposure level; SMA = seasonal management area; SPL = root-mean-square sound pressure level; SWDA = Southern Wind Development Area; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; UXO = unexploded ordnance; WTG = wind turbine generator
[a] BOEM 2021 BMPs available at: https://www.boem.gov/pdcs-and-bmps-atlantic-data-collection-11222021.

APPENDIX B

Mitigation Requirements Included in the MMPA Proposed Rule (88 FR 37606, June 8, 2023)

(a) *General conditions.* The following measures apply to the Project:

(1) A copy of any issued LOA must be in the possession of the 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 LOA;

(2) The LOA Holder must conduct briefings between construction supervisors, construction crews, and the PSO and PAM team prior to the start of all in-water construction activities and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring and reporting protocols, and operational procedures. A simple guide must be included with the Marine Mammal Monitoring Plan to aid personnel in identifying species if they are observed in the vicinity of the project area;

(3) Prior to and when conducting any in-water activities and vessel operations, the LOA Holder personnel (*e.g.*, vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the project area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (*i.e.*, Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators, PSO(s), and PAM operators;

(4) The LOA Holder must ensure that any visual observations of an Endangered Species Act (ESA)-listed marine mammal are communicated to on-duty PSOs, PAM operator(s), and vessel captains during the concurrent use of multiple project-associated vessels (of any size; *e.g.*, construction surveys, crew/supply transfers, *etc.*);

(5) The LOA Holder must establish and implement clearance and shutdown zones as described in the LOA;

(6) The LOA Holder must instruct all vessel personnel regarding the authority of the PSO(s). Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred;

(7) If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone for a specified activity, pile driving (*e.g.,* impact and vibratory), drilling, and HRG acoustic sources must shut down immediately, unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability, or be delayed if the activity has not commenced. Pile driving, drilling, UXO/MEC detonations, and initiation of HRG acoustic sources must not commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or the observation time has elapsed with no further sightings;

(8) Foundation Installation (*i.e.,* impact and vibratory pile driving, drilling), UXO/MEC detonation, and HRG survey activities shall only commence when visual clearance zones are fully visible (*e.g.*, not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of equipment

(*i.e.* vibratory and impact pile driving, drilling, UXO/MEC detonations, and HRG surveys that use boomers, sparkers, and Compressed High-Intensity Radiated Pulses (CHIRPs));

(9) 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;

(10) For in-water construction heavy machinery activities other than foundation installation, if a marine mammal is on a path towards or comes within 10 meters (m) of equipment, the 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;

(11) All vessels must be equipped with an Automatic Identification System (AIS) and the LOA Holder must report all Maritime Mobile Service Identify (MMSI) numbers to NMFS Office of Protected Resources prior to initiating in-water activities; and

(12) Confirmation of all required training must be documented on a training course log sheet and reported to NMFS Office of Protected Resources.

(b) *Vessel strike avoidance measures.* The following measures apply to all vessels associated with the Project:

(1) Prior to the start of the Project's activities involving vessels, all vessel operators and crew must receive a protected species identification training that covers, at a minimum:

(i) Identification of marine mammals and other protected species known to occur or which have the potential to occur in the LOA Holder's project area;

(ii) Training on making observations in both good weather conditions (*i.e*., clear visibility, low winds, low sea states) and bad weather conditions (*i.e.*, fog, high winds, high sea states, with glare);

(iii) Training on information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species; and

(iv) Training related to vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities.

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

(3) All transiting vessels operating at any speed must have a dedicated visual observer 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 degree starboards) located at the best vantage point for ensuring vessels are maintaining appropriate separation distances from marine mammals. Visual observers must be equipped with binoculars and 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 NMFS-approved PSOs or crew members. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of vessel use;

(4) Year-round and when a vessel is in transit, all vessel operators must continuously monitor U.S. Coast Guard VHF Channel 16, over which North Atlantic right whale sightings are broadcasted. At the onset of transiting and at least once every four hours, vessel operators and/or trained crew members must monitor the project's Situational Awareness System, WhaleAlert, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic

right whales. Any observations of any large whale by any of the LOA Holder's staff or contractors, including vessel crew, must be communicated immediately to PSOs, PAM operator, and all vessel captains to increase situational awareness. Conversely, any large whale observation or detection via a sighting network (*e.g.*, Mysticetus) by PSOs or PAM operators must be conveyed to vessel operators and crew;

(5) Any observations of any large whale by any LOA Holder staff or contractor, including vessel crew, must be communicated immediately to on-duty PSOs, PAM operators, and all vessel captains to increase situational awareness;

(6) Nothing in this subpart exempts vessels from applicable speed regulations at 50 CFR 224.105;

(7) All vessels must transit active Slow Zones (*i.e.*, Dynamic Management Areas (DMAs) or acoustically-triggered slow zone), and Seasonal Management Areas (SMAs) at 10 knots or less;

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

(9) All vessels, regardless of size, must immediately reduce speed to 10 knots or less when a North Atlantic right whale is sighted, at any distance, by anyone on the vessel;

(10) All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway and making way, all vessels must steer a course away from any sighted North Atlantic right whale at 10 knots 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 a transiting vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale;

(11) All vessels must maintain a minimum separation distance of 100 m from sperm whales and baleen whales other than North Atlantic right whales. If one of these species is sighted within 100 m of a transiting vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 100 m;

(12) All vessels must maintain a minimum separation distance of 50 m 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, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.*, bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m;

(13) When a marine mammal(s) is sighted while a vessel 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, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must shift the engine to neutral and not engage the engine(s) until the animal(s) outside and on a path away from the separation area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.*, any situation where the vessel is navigationally constrained);

(14) All 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 knots or less until the animal is outside the relevant separation distance; and

(15) The LOA Holder must submit a North Atlantic right whale Vessel Strike Avoidance Plan 180 days prior to the commencement of vessel use. This plan must describe, at a minimum, how PAM, in combination with visual observations, would be conducted to ensure the transit corridor is clear of right whales and would also provide details on the vessel-based observer

(c) *WTG and ESP foundation installation.* The following requirements apply to impact and vibratory pile driving and drilling activities associated with the installation of WTG and ESP foundations:

(1) Vibratory pile driving, impact pile driving, and drilling may not occur November 1st through April 30th;

(2) Monopiles must be no larger than 13-m in diameter, representing the larger end of a tapered monopile design. Pin piles must be no larger than 4 m in diameter. During all monopile and 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 6,000 kilojoules (kJ) for monopile installations and 3,500 kJ for pin pile installation. No more than two monopile foundation or four pin piles for jacket foundations may be installed per day;

(3) The LOA Holder must utilize a soft-start protocol for each impact pile driving event of all foundations by performing 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes;

(4) Soft-start must occur at the beginning of monopile and pin pile impact driving and at any time following a cessation of impact pile driving of 30 minutes or longer;

(5) At least four PSOs must be actively observing marine mammals before, during, and after installation of foundation piles (*i.e.*, monopiles and pin piles). At least two PSOs must be stationed and observing on the pile driving vessel and at least two PSOs must be stationed on a secondary, PSO-dedicated vessel. Concurrently, at least one PAM operator must be actively monitoring for marine mammals with PAM before, during, and after impact pile driving;

(6) PSOs must visually clear (*i.e.*, confirm no marine mammals are present) the entire minimum visibility zone and the entire clearance zone (when conditions all for visibility of the entire clearance zone) for a full 30 minutes immediately prior to commencing pile driving or drilling;

(7) If a marine mammal is detected, visually or acoustically, within or about to enter the applicable clearance zones, prior pile driving or drilling, activities 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 small odontocetes and pinnipeds and 30 minutes for all other species;

(8) The LOA Holder must deploy dual noise abatement systems that are capable of achieving, at a minimum, 10 decibel (dB) of sound attenuation, during all pile driving and drilling of monopiles and pin piles and comply with the following requirements related noise abatement:

(i) A single bubble curtain must not be used unless paired with another noise attenuation device;

(ii) A big double bubble curtain may be used without being paired with another noise attenuation device;

(iii) The bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 $m^3/(min*m)$. The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must make appropriate adjustments to the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved;

(iv) 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;

(v) No parts of the ring or other objects may prevent full seafloor contact;

(vi) Construction contractors must train personnel in the proper balancing of airflow to the ring. Construction contractors must submit an inspection/performance report for approval by the LOA Holder within 72 hours following the performance test. The LOA Holder must then submit that report to NMFS Office of Protected Resources; and

(vii) Corrections to the bubble ring(s) to meet the performance standards in this paragraph (c)(7) must occur prior to impact pile driving of monopiles and pin piles. If the LOA Holder uses a noise mitigation device in addition to the bubble curtain, the LOA Holder must maintain similar quality control measures as described in this paragraph (c)(7).

(9) At least one PAM operator must review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. All clearance zones must be acoustically confirmed to be free of marine mammals for 60 minutes before activities can begin immediately prior to starting a soft-start of impact pile driving. PAM operators will continue to monitor for marine mammals for at least 30 minutes after pile driving or drilling concludes;

(10) 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 confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred within the PAM clearance zone during the 60-minute monitoring period. Any large whale sighting by a PSO or detected by a PAM operator that cannot be identified by species must be treated as if it were a North Atlantic right whale;

(11) If a marine mammal is observed entering or within the respective shutdown zone after pile driving has begun, the PSO must call for a shutdown of pile driving or drilling. The LOA Holder must stop pile driving or drilling 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. In any of these situations, the 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;

(12) 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;

(13) If pile driving has been shut down due to the presence of a marine mammal other than an North Atlantic right whale, pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species. In cases where these

criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time the LOA Holder must use the lowest hammer energy practicable to maintain stability;

(14) The LOA Holder must conduct sound field verification (SFV) during all foundation installation activities:

(i) The LOA Holder must conduct SFV during all activities associated with the first three WTG foundations and the first two jacket foundations installed. Subsequent SFV is required should additional piles be driven that are anticipated to produce louder sound fields than those previously measured;

(ii) The LOA Holder must conduct SFV during drilling the first time it occurs;

(iii) The LOA Holder must determine source levels, spectra, the ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds, and transmission loss coefficient(s);

(iv) The LOA Holder must perform sound field measurements at a minimum of four distances from the pile being driven in one direction (towards deepest waters), including, but not limited to, 750 m and the modeled Level B harassment zones assuming 10 dB attenuation to verify the accuracy of those modeled zones and contribute to improvement of the models. At least one additional measurement at a different azimuth must be taken to capture sound propagation variability;

(v) The recordings must be continuous throughout the duration of all pile driving and drilling of each foundation monitored;

(vi) The 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;

(vii) The frequency range of the system must cover the range of at least 20 hertz (Hz) to 20 kilohertz (kHz);

(viii) The system must be designed to have omnidirectional sensitivity and so that the broadband received level of all pile driving and drilling activities exceeds the system noise floor by at least 10 dB. The dynamic range of the system must be sufficient such that at each location, pile driving signals are not clipped and are not masked by noise floor;

(ix) If acoustic field measurements collected during installation of foundation piles indicate ranges to the isopleths, corresponding to Level A harassment and Level B harassment thresholds, are greater than the ranges predicted by modeling (assuming 10 dB attenuation), the LOA Holder must implement additional noise mitigation measures prior to installing the next foundation. Additional acoustic measurements must be taken after each modification;

(x) In the event that field measurements indicate ranges to isopleths, corresponding to Level A harassment and Level B harassment thresholds, are greater than the ranges predicted by modeling (assuming 10 dB attenuation) after implementing additional noise mitigation measures, NMFS Office of Protected Resources may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols;

(xi) If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), the 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, the LOA Holder must have had to conduct SFV on an additional three foundations and that subsequent foundations would be installed under conditions that are predicted to produce smaller harassment zones than those measured;

(xii) The LOA Holder must conduct SFV after construction is complete to estimate turbine operational source levels based on measurements in the near and far-field at a minimum of three locations from each foundation monitored. These data must be used to also identify estimated transmission loss rates; and

(xiii) The LOA Holder must submit an SFV plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of foundation installation activities.

(d) *UXO/MEC detonations.* The following requirements apply to Unexploded Ordnances and Munitions and Explosives of Concern (UXO/MEC) detonations:

(1) Upon encountering a UXO/MEC, LOA Holder may only resort to high-order removal (*i.e.,* detonation) if all other means of removal are impracticable;

(2) UXO/MEC detonations must not occur from January 1 through April 30, annually;

(3) UXO/MEC detonations must only occur during daylight hours;

(4) No more than one detonation can occur within a 24-hour period;

(5) The LOA Holder must deploy dual noise abatement systems during all UXO/MEC detonations and comply with the following requirements related noise abatement:

(i) A single bubble curtain must not be used unless paired with another noise attenuation device;

(ii) A big double bubble curtain may be used without being paired with another noise attenuation device;

(iii) The bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 m^3/(min*m). The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must make appropriate adjustments to the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved;

(iv) 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;

(v) No parts of the ring or other objects may prevent full seafloor contact;

(vi) Construction contractors must train personnel in the proper balancing of airflow to the ring. Construction contractors must submit an inspection/performance report for approval by the LOA Holder within 72 hours following the performance test. The LOA Holder must then submit that report to NMFS Office of Protected Resources; and

(vii) Corrections to the bubble ring(s) to meet the performance standards in this paragraph (e)(5) must occur prior to UXO/MEC detonations. If the LOA Holder uses a noise mitigation device in addition to the bubble curtain, the LOA Holder must maintain similar quality control measures as described in this paragraph (e)(5);

(6) The LOA Holder must conduct SFV during all UXO/MEC detonations at a minimum of three locations (at two water depths at each location) from each detonation in a direction toward deeper water in consideration of the following:

(i) The LOA Holder must empirically determine source levels (peak and cumulative sound exposure level), the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds in meters, and the transmission loss coefficient(s). The LOA Holder may estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from *in situ* measurements conducted at several distances from the detonation location monitored;

(ii) The measurement systems must have a sensitivity appropriate for the expected sound levels from detonations received at the nominal ranges throughout the detonation;

(iii) The frequency range of the system must cover the range of at least 20 Hz to 20 kHz; and

(iv) The system will be designed to have omnidirectional sensitivity and will be designed so that the predicted broadband received level of all UXO/MEC detonations exceeds the system noise floor by at least 10 dB. The dynamic range of the system must be sufficient such that at each location, pile driving signals are not clipped and are not masked by noise floor.

(7) The LOA Holder must submit an SFV plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of detonation activities;

(8) LOA Holder must establish and implement clearance zones for UXO/MEC detonation using both visual and acoustic monitoring, as described in the LOA;

(9) LOA Holder must use at least two visual PSOs on each platform (*e.g.,* vessels, plane) and one PAM operator to monitor for marine mammals in the clearance zones prior to detonation. If the clearance zone is larger than 2 km (based on charge weight), LOA Holder must deploy a secondary PSO vessel or aircraft. If the clearance is larger than 5 km (based on charge weight), an aerial survey must be conducted;

(10) At least four PSOs must be actively observing marine mammals before and after any UXO/MEC detonation. At least two PSOs must be stationed and observing on a vessel as close as possible to the detonation site and at least two PSOs must be stationed on a secondary, PSO-dedicated vessel or aerial platform. Concurrently, at least one acoustic monitoring PSO (*i.e.*, passive acoustic monitoring (PAM) operator) must be actively monitoring for marine mammals with PAM before, during, and after impact pile driving;

(11) At least one PAM operator must review data from at least 24 hours prior to a detonation and actively monitor hydrophones for 60 minutes prior to detonation. All clearance zones must be acoustically confirmed to be free of marine mammals for 60 minutes before activities can begin immediately prior to commencing a detonation. PAM operators will continue to monitor for marine mammals at least 30 minutes after a detonation;

(12) All clearance zones must be visually confirmed to be free of marine mammals for 30 minutes before a detonation can occur. All PSOs will also maintain watch for 30 minutes after the detonation event;

(13) If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of a detonation, detonation must be delayed and must not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually and acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species; and

(14) For North Atlantic right whales, any visual observation or acoustic detection must trigger a delay to the detonation of a UXO/MEC. Any large whale sighting by a PSO or detected by a PAM operator that cannot be identified by species must be treated as if it were a North Atlantic right whale.

(e) *HRG surveys.* The following requirements apply to HRG surveys operating sub bottom profilers (SBPs) (i.e., boomers, sparkers, and CHIRPS):

(1) The LOA Holder is required to have at least one PSO on active duty per HRG vessel during HRG surveys that are conducted during daylight hours (*i.e.*, from 30 minutes prior to civil

sunrise through 30 minutes following civil sunset) and at least two PSOs on active duty per vessel during HRG surveys that are conducted during nighttime hours;

(2) The LOA Holder must deactivate acoustic sources during periods where no data are being collected, except as determined to be necessary for testing. Unnecessary use of the acoustic source(s) is prohibited;

(3) The LOA Holder is required to ramp-up sub-bottom profilers (SBPs) prior to commencing full power, unless the equipment operates on a binary on/off switch. ensure visual clearance zones are fully visible (*e.g.*, not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using acoustic sources specified in the LOA;

(4) Prior to a ramp-up procedure starting or activating SBPs, the operator must notify the Lead PSO of the planned start time. This notification time must not be less than 60 minutes prior to the planned ramp-up or activation as all relevant PSOs must monitor the clearance zone for 30 minutes prior to the initiation of ramp-up or activation;

(5) Prior to starting the survey and after receiving confirmation from the PSOs that the clearance zone is clear of any marine mammals, the LOA Holder must ramp-up sources to half power for 5 minutes and then proceed to full power, unless the source operates on a binary on/off switch in which case ramp-up is not required. Ramp-up and activation must be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up and activation may only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species, has elapsed with no further sightings;

(6) The 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;

(7) If a marine mammal is observed within a clearance zone during the clearance period, ramp-up or acoustic surveys may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sighting. The specific time period is 15 minutes for small odontocetes and seals, and 30 minutes for all other species;

(8) Any large whale sighted by a PSO within 1 km of the SBP that cannot be identified by species must be treated as if it were a North Atlantic right whale and the LOA Holder must apply the mitigation measure applicable to this species;

(9) 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 would be allowed to commence (*i.e.*, no delay is required) despite periods of inclement weather and/or loss of daylight;

(10) Once the survey has commenced, the LOA Holder must shut down SBPs if a marine mammal enters a respective shutdown zone, except in cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.*, no shutdown is required) so long as no marine mammals have been detected. The 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 (f)(10) is detected in the shutdown zone;

(11) If SBPs have been shut down due to the presence of a marine mammal, the use of SBPs 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 small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting;

(12) The LOA Holder must immediately shutdown any SBP 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 (f)(12) is detected in the shutdown zone;

(13) If a SBP is shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if:

(i) PSOs have maintained constant observation; and

(ii) 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 using trap and trawl gear:

(1) All captains and crew conducting fishery surveys must be trained in marine mammal detection and identification. Marine mammal monitoring will be conducted by the trained captain and/or a member of the scientific crew before (within 1 nautical mile (nm) and 15 minutes prior to deploying gear), during, and for 15 minutes after haul back;

(2) Survey gear will be deployed as soon as possible once the vessel arrives on station;

(3) The 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 nm of the planned location and 15 minutes before gear deployment, then the 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, the LOA Holder and/or its cooperating institutions, contracted vessels, or commercially-hired captains must move again or skip the station;

(4) If a marine mammal is deemed to be at risk of interaction after the gear is 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 will slow its speed and maneuver the vessel away from the animals to minimize potential interactions with the observed animal;

(5) The LOA Holder must maintain visual monitoring effort during the entire period of time that gear is in the water (*i.e.*, throughout gear deployment, fishing, and retrieval);

(6) All fisheries monitoring gear must be fully cleaned and repaired (if damaged) before each use;

(7) The LOA Holder must implement the gear marking requirements and restriction measures for the Project gear detailed within the Atlantic Large Whale Take Reduction Plan at 50 CFR 229.32;

(8) Trawl tows will be limited to a 20-minute trawl time at 3.0 knots;

(9) All gear, trawl or otherwise, will be emptied immediately after retrieval within the vicinity of the deck;

(i) During trawl surveys, vessel crew will 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) During any survey that uses vertical lines, buoy lines will be weighted and will not float at the surface of the water and all groundlines will consist of sinking line. All groundlines must be composed entirely of sinking line. 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;

(11) All in-water survey gear will be properly labeled with the scientific permit number or identification as LOA Holder- related research gear. All labels and markings on the buoys and buoy lines will also be compliant with the applicable regulations, and all buoy markings will comply with instructions received by the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division; and

(12) All survey gear will be removed from the water whenever not in active survey use (*i.e.,* no wet storage). All reasonable efforts, that do not compromise human safety, must be undertaken to recover gear. All lost gear must be reported to NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division (*nmfs.gar.incidental-take@noaa.gov*) 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;

§ 217.325 Requirements for monitoring and reporting.

(a) *Protected species observer (PSO) and passive acoustic monitoring (PAM) operator qualifications.* The LOA Holder must implement the following measures applicable to PSOs and PAM operators:

(1) The LOA Holder must use independent, dedicated, qualified 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 vessel crew with regard to the presence of protected species and mitigation requirements;

(2) 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 shall 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; and the PSO/PAM operator should demonstrate good standing and consistently good performance of PSO/PAM duties;

(3) PSOs and PAM operators must successfully complete relevant training within the last 5 years, including obtaining a certificate of course completion;

(4) 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 of when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior; 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;

(5) All PSOs and PAM operators must be approved by the NMFS Office of Protected Resources. The LOA Holder must submit PSO resumes for NMFS Office of Protected Resources review and approval at least 90 days prior to commencement of in-water construction activities requiring PSOs and PAM operators. Resumes must include dates of training and any prior NMFS Office of Protected Resources approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS Office of Protected Resources shall be allowed three weeks to approve PSOs from the time that the necessary information is received by NMFS Office of Protected Resources, after which PSOs meeting the minimum requirements will automatically be considered approved;

(6) All PSOs must be trained in marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations;

(7) At least one PSO on active duty for each activity (*i.e.*, foundation installation, UXO/MEC detonation activities, and HRG surveys) must be designated as the “Lead PSO”. The Lead PSO must have a minimum of 90 days of at-sea experience working in an offshore environment and is required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience;

(8) PAM operators must complete specialized training for operating PAM systems and must demonstrate familiarity with the PAM system on which they must be working; and

(9) 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 in consideration of both roles.

(b) *General PSO and PAM operator requirements.* The following measures apply to PSOs and PAM operators and must be implemented by the LOA Holder:

(1) PSOs must monitor for marine mammals prior to, during, and following pile driving, drilling, UXO/MEC detonation activities, and during HRG surveys that use sub- bottom profilers (with specific monitoring durations and needs described in paragraphs (c) through (f) of this section, respectively).

(2) PAM operator(s) must acoustically monitor for marine mammals prior to, during, and following all pile driving, drilling, and UXO/MEC detonation activities. PAM operators may be located on a vessel or remotely on-shore but must have the appropriate equipment (*i.e.*, computer station equipped with a data collection software system available wherever they are stationed and be in real-time communication with PSOs and transiting vessel captains;

(3) All PSOs must be located at the best vantage point(s) on any platform, 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.

(4) All on-duty visual PSOs must remain in contact with the on-duty PAM operator, who would monitor the PAM systems for acoustic detections of marine mammals in the area, regarding any animal detection that might be approaching or found within the applicable zones no matter where the PAM operator is stationed (*ie.eg.*, onshore or on a vessel);

(5) During all visual observation periods during the Project, PSOs must use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During all pile driving and drilling, at least one PSO on the primary pile driving 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;

(6) During all acoustic monitoring periods during the Project, PAM operators must use PAM systems as approved by NMFS;

(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;

(8) PSOs and PAM operators must not exceed four consecutive watch hours on duty at any time, must have a two-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period;

(9) Any PSO or PAM operator has the authority to call for a delay or shutdown of project activities;

(10) PSOs must remain in real-time contact with the PAM operators and construction personnel responsible for implementing mitigation (e.g., delay to pile driving or UXO/MEC detonation) 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; and

(11) The LOA Holder is required to use available sources of information on North Atlantic right whale presence to aid in monitoring efforts. These include daily monitoring of the Right Whale Sightings Advisory System, consulting of the WhaleAlert app, and monitoring of the Coast Guard's VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas, to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with North Atlantic right whales.

(c) *PSO and PAM operator requirements during WTG and ESP foundation installation.* The following measures apply to PSOs and PAM operators during WTG and ESP foundation installation and must be implemented by the LOA Holder:

(1) If PSOs cannot visually monitor the minimum visibility zone at all times using the equipment described in paragraphs (b)(3) and(4) of this section, pile driving operations must not commence or must shutdown if they are currently active;

(2) All PSOs must begin monitoring 60 minutes prior to pile driving, during, and for 30 minutes after the activity. Pile driving must only commence when the minimum visibility zone is fully visible (*e.g.*, not obscured by darkness, rain, fog, *etc*.) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of pile driving. PAM operators must assist the visual PSOs in monitoring by

conducting PAM activities 60 minutes prior to any pile driving, during, and after for 30 minutes for the appropriate size PAM clearance zone (dependent on season). The entire minimum visibility zone must be clear for at least 30 minutes, with no marine mammal detections within the visual or PAM clearance zones prior to the start of pile driving;

(3) The LOA Holder must conduct PAM for at least 24 hours immediately prior to pile driving activities;

(4) During use of any real-time PAM system, at least one PAM operator must be designated to monitor each system by viewing data or data products that would be streamed in real-time or in near real-time to a computer workstation and monitor;

(5) The PAM operator must inform the Lead PSO(s) on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.*, Mysticetus or similar system) who will be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.*, delay or shutdown); and

(6) The LOA Holder must prepare and submit a Foundation Installation and Marine Mammal Monitoring Plan to NMFS Office of Protected Resources for review and approval at least 180 days before the start of any pile driving. The plan must include final pile driving project design (*e.g.*, number and type of piles, hammer type, noise abatement systems, anticipated start date, *etc.*) and all information related to PAM and PSO monitoring protocols for foundation installation activities.

(e) *PSO requirements during UXO/MEC detonations.* The following measures apply to PSOs during HRG surveys using SBPs and must be implemented by the LOA Holder:

(1) All on-duty visual PSOs must remain in contact with the on-duty PAM operator, who would monitor the PAM systems for acoustic detections of marine mammals in the area, regarding any animal detection that might be approaching or found within the applicable zones no matter where the PAM operator is stationed (*e.g.*, onshore or on a vessel);

(2) If PSOs cannot visually monitor the minimum visibility zone at all times using the equipment described in paragraphs (b)(3) and(4) of this section; UXO/MEC operations must not commence or must shutdown if they are currently active;

(3) All PSOs must begin monitoring 60 minutes prior to UXO/MEC detonation, during, and for 30 minutes after the activity. Pile driving must only commence when the minimum visibility zone is fully visible (*e.g.*, not obscured by darkness, rain, fog, *etc*.) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of detonation. PAM operators must assist the visual PSOs in monitoring by conducting PAM activities 60 minutes prior to any UXO/MEC detonation, during, and after for 30 minutes for the appropriate size PAM clearance zone. The entire minimum visibility zone must be clear for at least 30 minutes, with no marine mammal detections within the visual or PAM clearance zones prior to the initiation of detonation;

(4) For North Atlantic right whales, any visual or acoustic detection must trigger a delay to the commencement of UXO/MEC detonation. In the event that a large whale is sighted or acoustically detected that cannot be confirmed by species, it must be treated as if it were a North Atlantic right whale;

(5) The LOA Holder must conduct PAM for at least 24 hours immediately prior to foundation installation and UXO/MEC detonation activities;

(6) During use of any real-time PAM system, at least one PAM operator must be designated to monitor each system by viewing data or data products that would be streamed in real-time or in near real-time to a computer workstation and monitor;

(7) The LOA Holder must use a minimum of one PAM operator to actively monitor for marine mammals before, during, and after UXO/MEC detonation. The PAM operator must assist visual PSOs in ensuring full coverage of the clearance and shutdown zones. 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 will be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.*, delay or shutdown);

(8) PAM operators must be on watch for a maximum of four consecutive hours, followed by a break of at least two hours between watches, and may not exceed a combined watch schedule of more than 12 hours in a single 24-hour period;

(9) The LOA Holder must prepare and submit a Foundation Installation and Marine Mammal Monitoring Plan to NMFS Office of Protected Resources for review and approval at least 180 days before the start of any detonation. The plan must include final UXO/MEC detonation project design (*e.g.*, number and type of UXO/MECs, removal method(s), charge weight(s), anticipated start date, *etc.*) and all information related to PAM and PSO monitoring protocols for UXO/MEC activities; and

(10) A Passive Acoustic Monitoring Plan ("PAM Plan") must be submitted to NMFS Office of Protected Resources for review and approval at least 180 days prior to the planned start of foundation installation and prior to the start of any UXO/MEC detonation(s). The authorization to take marine mammals would be contingent upon NMFS Office of Protected Resources approval of the PAM Plan.

(f) *PSO requirements during HRG surveys.* The following measures apply to PSOs during HRG surveys using SBPs and must be implemented by the 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 SBPs during the use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased;

(4) During daylight hours when survey equipment is not operating, the 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; and

(5) Any acoustic monitoring would complement visual monitoring efforts and would cover an area of at least the Level B harassment zone around each acoustic source.

(g) *Reporting.* The LOA Holder must comply with the following reporting measures:

(1) Prior to initiation of in-water project activities, the LOA Holder must demonstrate in a report submitted to NMFS Office of Protected Resources that all required training for the LOA Holder personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed;

(2) The LOA Holder must use a standardized reporting system during the effective period of the LOA. All data collected related to the Project must be recorded using industry-standard softwares that is installed on field laptops and/or tablets.

(3) For all monitoring efforts and marine mammal sightings, the following information must be collected and reported:

(i) Date and time that monitored activity begins or ends;

(ii) Construction activities occurring during each observation period;

(iii) Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(iv) PSO who sighted the animal;

(v) Time of sighting;

(vi) Weather parameters (*e.g.*, wind speed, percent cloud cover, visibility);

(vii) Water conditions (*e.g.*, sea state, tide state, water depth);

(viii) All marine mammal sightings, regardless of distance from the construction activity;

(ix) Species (or lowest possible taxonomic level possible);

(x) Pace of the animal(s);

(xi) Estimated number of animals (minimum/maximum/high/low/best);

(xii) Estimated number of animals by cohort (*e.g.*, adults, yearlings, juveniles, calves, group composition, *etc*.);

(xiii) Description (*i.e*., as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

(xiv) Description of any marine mammal behavioral observations (*e.g.*, observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity;

(xv) Animal's closest distance and bearing from the pile being driven or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zone(s);

(xvi) 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.*);

(xvii) Marine mammal occurrence in Level A harassment or Level B harassment zones;

(xviii) Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.*, delay, shutdown, *etc*.) and time and location of the action; and

(xix) Other human activity in the area.

(3) If a marine mammal is acoustically detected during PAM monitoring, the following information must be recorded and reported to NMFS Office of Protected Resources:

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

(ii) Bottom depth and depth of recording unit (in meters);

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

(iv) Time zone for sound files and recorded date/times in data and metadata (in relation to Universal Coordinated Time (UTC); *i.e.*, Eastern Standard Time (EST) time zone is UTC-5);

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

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

(vii) Recording schedule (must be continuous);

(viii) Hydrophone and recorder sensitivity (in dB re. 1 microPascal (μPa));

(ix) Calibration curve for each recorder;

(x) Bandwidth/sampling rate (in Hz);

(xi) Sample bit-rate of recordings; and

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

(4) Information required for each detection, the following information must be noted:

(i) Species identification (if possible);

(ii) Call type and number of calls (if known);

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

(iv) Confidence of detection (detected, or possibly detected);

(v) Comparison with any concurrent visual sightings;

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

(vii) Location of recorder and construction activities at time of call;

(viii) Name and version of detection or sound analysis software used, with protocol reference;

(ix) Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and

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

(4) The LOA Holder must compile and submit weekly reports to NMFS Office of Protected Resources that document the daily start and stop of all pile driving, UXO/MEC detonations, and HRG survey 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 – 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). This weekly report must also identify when, what charge weight size, and where UXO/MECs are detonated (a map must also be provided). Once all foundation pile installation and UXO/MEC detonations are completed, weekly reports are no longer required by the LOA Holder;

(6) The LOA Holder must compile and submit monthly reports to NMFS Office of Protected Resources that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The monthly report must also identify which turbines become operational and when (a map must be provided). This weekly report must also identify when, what charge weight size, and where UXO/MECs are detonated (a map must also be provided). Once foundation installation and UXO/MEC detonations are completed, monthly reports are no longer required;

(7) The 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. The LOA Holder must provide a final report within 30 days following resolution of comments on the draft report. The draft and final reports must detail the following information:

(i) 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;

(ii) Marine mammal detections and behavioral observations before, during, and after each activity;

(iii) What mitigation measures were implemented (*i.e.*, number of shutdowns or clearance zone delays, *etc.*) or, if no mitigative actions was taken, why not;

(iv) Operational details (*i.e.*, days and duration of impact and vibratory pile driving, days and duration of drilling, days and number of UXO/MEC detonations, days and amount of HRG survey effort, *etc*.);

(v) Any PAM systems used;

(vi) The results, effectiveness, and which noise attenuation systems were used during relevant activities (*i.e*., impact and vibratory pile driving, drilling, and UXO/MEC detonations);

(vii) Summarized information related to situational reporting;

(viii) Any other important information relevant to the Project, including additional information that may be identified through the adaptive management process; and

(ix) The final annual report must be prepared and submitted within 30 calendar days following the receipt of any comments from NMFS Office of Protected Resources 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 must be considered final.

(8) The 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 LOA. 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;

(9) The LOA Holder must submit a SFV plan at least 180 days prior to the planned start of vibratory and impact pile driving, drilling, and UXO/MEC detonations. At minimum, the plan must describe how the LOA Holder would ensure that the first three monopiles and all ESP jackets (using pin piles) foundation installation sites selected for SFV are representative of the rest of the monopile and pin pile installation sites. In the case that these sites/scenarios are not determined to be representative of all other monopile/pin pile installation sites, the LOA Holder must include information on how additional sites/scenarios would be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS Office of Protected Resources. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. The LOA Holder must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS Office of Protected Resources in an interim report after each monopile for the first three piles, after two jacket foundation using pin piles are installed, and after each UXO/MEC detonation; and

(i) The SFV plan must also include how operational noise would be monitored. These data must be used to identify estimated transmission loss rates. Operational parameters (*e.g.,* direct drive/gearbox information, turbine rotation rate), characteristics about the UXO/MEC (*e.g.*, charge weight, size, type of charge), as well as sea state conditions and information on nearby anthropogenic activities (*e.g.*, vessels transiting or operating in the area) must be reported.

(ii) The 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 for the first three WTG foundations piles and two ESP jacket foundations, and for each UXO/MEC detonated, as soon as they are available, but no later than 48 hours after each completed installation event and/or detonation. The LOA Holder must also provide interim reports on any subsequent SFV on foundation piles within 48 hours. The interim pile driving SFV report must include hammer energies used during pile driving, peak sound pressure level (SPL_{pk}) and median, mean, maximum, and minimum root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}) and single strike sound exposure level (SEL_{ss});

(iii) The final results of SFV of foundation installations and UXO/MEC detonations must be submitted as soon as possible, but no later than within 90 days following completion of all foundation installation of monopiles and jackets (pin piles) and all necessary detonation events. The final report must include, at minimum, the following:

(A) Peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), single strike sound exposure level (SEL_{ss}), integration time for SPL_{rms}, spectrum, and 24-hour cumulative SEL extrapolated from measurements at specified distances (*e.g*., 750 m) in mean, median, maximum and minimum levels;

(B) The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported;

(C) The sound levels reported must be in median and linear average (*i.e.*, average in linear space), and in dB;

(D) A description of depth and sediment type, as documented in the Construction and Operation Plan (COP), at the recording and foundation installation and UXO/MEC detonation locations;

(E) Hammer energies required for pile installation and the number of strikes per pile;

(F) Charge weights and other relevant characteristics of UXO/MEC detonations;

(G) Hydrophone equipment and methods (*i.e*., recording device, bandwidth/sampling rate, distance from the monopile/pin pile and/or UXO/MEC where recordings were made; depth of recording device(s));

(H) Description of the SFV PAM hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information;

(I) 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);

(J) Spatial configuration of the noise attenuation device(s) relative to the pile and/or UXO/MEC charge;

(K) The extents of the Level A harassment and Level B harassment zone(s); and

(L) A description of the noise abatement system and operational parameters (*e.g.*, bubble flow rate, distance deployed from the pile and/or UXO/MEC, *etc.*) and any action taken to adjust the noise abatement system.

(10) The LOA Holder must submit situational reports if the following circumstances occur:

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

(ii) When an observation of a large whale occurs during vessel transit, the following information must be recorded and reported to NMFS Office of Protected Resources:

(A) Time, date, and location (latitude/longitude; in Decimal Degrees);

(B) The vessel's activity, heading, and speed;

(C) Sea state, water depth, and visibility;

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

(E) Initial distance and bearing to marine mammal from vessel and closest point of approach; and

(F) Any avoidance measures taken in response to the marine mammal sighting.

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

(iv) In the event that the personnel involved in the Project discover a stranded, entangled, injured, or dead marine mammal, the LOA Holder must immediately report the observation to the NMFS Office of Protected Resources, the NMFS Greater Atlantic Stranding Coordinator for the New England/Mid-Atlantic area (866-755-6622), and the U.S. Coast Guard within 24 hours. If the injury or death was caused by a project activity, the LOA Holder must immediately cease all activities until NMFS Office of Protected Resources is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS Office of Protected Resources may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. The LOA Holder may not resume their activities until notified by NMFS Office of Protected Resources. The report must include the following information:

(A) Time, date, and location (latitude/longitude; in Decimal Degrees) of the first discovery (and updated location information if known and applicable);

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

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

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

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

(F) General circumstances under which the animal was discovered.

(v) In the event of a vessel strike of a marine mammal by any vessel associated with the Project, the LOA Holder must immediately report the strike incident to the NMFS Office of Protected Resources and the NMFS Greater Atlantic Regional Fisheries Office within and no later than 24 hours. The LOA Holder must immediately cease all on-water activities until NMFS Office of Protected Resources is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS Office of Protected Resources may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. The LOA Holder may not resume their activities until notified by NMFS Office of Protected Resources. The report must include the following information:

(A) Time, date, and location (latitude/longitude; in Decimal Degrees) of the incident;

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

(C) Vessel's speed leading up to and during the incident;

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

(E) Status of all sound sources in use;

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

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

(H) Estimated size and length of animal that was struck;

(I) Description of the behavior of the marine mammal immediately preceding and following the strike;

(J) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

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

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

(11) LOA Holder must report any lost gear associated with the fishery surveys to the NOAA Greater Atlantic Regional Fisheries Office 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