SouthCoast Wind Project Biological Assessment

For the National Marine Fisheries Service

June 2024

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

BOEM
Bureau of Ocean Energy Management

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1. Introduction

This document transmits the Bureau of Ocean Energy Management's (BOEM) biological assessment (BA) in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code [U.S.C.] 1531 et seq.), on the effects of the Proposed Action on ESA-listed species and designated critical habitat that occur in the Action Area.

The Proposed Action described in this BA entails the construction, operation and maintenance (O&M), and decommissioning of the SouthCoast Wind Project in Lease Area OCS-A 0521 (the Project or Proposed Action).[1] SouthCoast Wind Energy LLC (hereafter SouthCoast Wind) is proposing to construct and operate a commercial-scale offshore wind energy facility within Lease OCS-A 0521 (Lease Area) that would generate approximately 2,400 megawatts of electricity. The Lease Area encompasses 127,388 acres (51,552 hectares) located in federal waters off the southern coast of Massachusetts, 26 nautical miles (48 kilometers) south of Martha's Vineyard and 20 nautical miles (37 kilometers) south of Nantucket, Massachusetts, in the Massachusetts Wind Energy Area (WEA); it will deliver power via undersea cables to Massachusetts, with a preferred landfall at Brayton Point in Somerset, Massachusetts, and a variant landfall option in Falmouth, Massachusetts, and then be connected to the power grid.

BOEM is the lead federal agency for purposes of Section 7 consultation and coordination under the National Environmental Policy Act (NEPA); the other action agencies (i.e., Federal agencies that are proposing to authorize, fund, or carry out the Proposed Action) 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 (USEPA), and the National Marine Fisheries Service (NMFS) Office of Protected Resources. SouthCoast Wind has submitted the construction and operations plan (COP) for the SouthCoast Wind Project to BOEM for review and approval. Consistent with the requirements of 30 Code of Federal Regulations (CFR) 585.620 to 585.635, COP submittal occurs after BOEM grants a lease and an applicant completes all studies and surveys defined in their site assessment plan (SAP). BOEM's renewable energy development process is described in Section 2.

[1] On February 1, 2023, Mayflower Wind Energy LLC changed its name to SouthCoast Wind Energy LLC and changed the project name from the Mayflower Wind Project to the SouthCoast Wind Project. The Mayflower Wind name has been updated to SouthCoast Wind throughout this document, but references to certain documents may still refer to Mayflower Wind.

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2. Regulatory Background and Consultation History

The Energy Policy Act of 2005 (EPAct), Public Law 109-58, added section 8(p)(1)(c) to the Outer Continental Shelf Lands Act. This section authorized the Secretary of Interior (Secretary) 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. These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove SouthCoast Wind's COP.

Under BOEM's renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a phased decision-making process. BOEM's wind energy program occurs in four distinct phases:

1. **Phase 1.** Planning and Analysis (complete). The first phase of the renewable energy process is to identify suitable areas to be considered for wind energy leases through collaborative, consultative, and analytical processes using the states' task forces; public information meetings; and input from the states, Native American tribes, and other stakeholders.
2. **Phase 2.** Lease Issuance (complete). The second phase is the issuance of a commercial wind energy lease. The competitive lease process is set forth at 30 CFR 585.210 to 585.225, and the noncompetitive process is set forth at 30 CFR 585.230 to 585.232. A commercial lease gives the lessee the exclusive right to subsequently seek BOEM approval for the development of the leasehold. The lease does not grant the lessee the right to construct any facilities; rather, the lease grants the right to use the leased area to develop its plans, which must be approved by BOEM before the lessee can move on to the next phase of the process (30 CFR 585.600 and 585.601).
3. **Phase 3.** Approval of site assessment plan (SAP) (complete). The third phase of the renewable energy development process is the submission of a SAP, which contains the lessee's detailed proposal for the construction of a meteorological tower and/or the installation of meteorological buoys on the leasehold (30 CFR 585.605 to 585.618). The lessee's SAP must be approved by BOEM before it conducts these "site assessment" activities on the leasehold. BOEM may approve, approve with modification, or disapprove a lessee's SAP (30 CFR 585.613). As a condition of SAP approval, meteorological towers will be required to have visibility sensors to collect data on climatic conditions above and beyond wind speed, direction, and other associated metrics generally collected at meteorological towers. These data will assist BOEM and the U.S. Fish and Wildlife Service (USFWS) with evaluating the impacts of future offshore wind facilities on threatened and endangered birds, migratory birds, and bats.
4. **Phase 4.** Approval of COP. The fourth and final phase of the process is the submission of a COP; a detailed plan for the construction and operation of a wind energy farm on the Lease Area (30 CFR 585.620 to 585.635). BOEM approval of a COP is a precondition to the construction of any wind energy facility on the OCS (30 CFR 585.628). As with a SAP, BOEM may approve, approve with modification, or disapprove a lessee's COP (30 CFR 585.628).

As noted, phases 1 through 3 have been completed for the Project. On October 19, 2018, BOEM published a Final Sale Notice in the *Federal Register* (FR), which stated a commercial lease sale would be held December 13, 2018, for the WEA offshore Massachusetts. BOEM offered three leases, including OCS-A 0521, which are located within the former Leases OCS-A 0502 and OCS-A 0503 that were unsold during the ATLW-4 sale on January 29, 2015. SouthCoast Wind was the winner of Lease OCS-A 0521. On April 1, 2019, BOEM and SouthCoast Wind executed the lease agreement for Lease OCS-A 0521. On May 26, 2020, BOEM approved SouthCoast Wind's SAP.

As part of Phase 4, SouthCoast Wind has completed site characterization activities and has developed a COP in accordance with BOEM regulations. On February 15, 2021, SouthCoast Wind submitted its COP for the construction, operations, and conceptual decommissioning of the Project within the Lease Area. SouthCoast Wind submitted updated versions of the COP on August 30, 2021, October 28, 2021, March 17, 2022, December 22, 2022, and September 19, 2023. On November 1, 2021, BOEM published a Notice of Intent to Prepare an EIS for SouthCoast Wind's Proposed Wind Energy Facility Offshore Massachusetts (86 CFR part 60274). A draft EIS was published on February 17, 2023.

BOEM is the lead Federal action agency and is requesting ESA section 7 consultation with NMFS Greater Atlantic Regional Fisheries Office (GARFO) on the proposed approval of the COP for the SouthCoast Wind offshore wind energy facility and offshore export cables, as well as other permits and approvals from other agencies that are associated with the approval of the COP. This BA considers the effects of the Proposed Action on ESA-listed whales, sea turtles, fish, and designated critical habitat in the Action Area. This BA is being submitted concurrently with a request for initiation of ESA Section 7 consultation. The proposed federal actions described in this request for consultation include: BSEE's enforcement of COP conditions and ESA terms and conditions; USEPA's proposal to issue an OCS Air Permit; USEPA's proposal to issue a National Pollutant Discharge Elimination System (NPDES) permit(s); USACE's potential issuance of a permit for in-water work and placement of structures within navigable waters of the U.S. under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) and the discharge of dredged or fill material into waters of the U.S. under Section 404 of the Clean Water Act (33 U.S.C. § 1344); NMFS' proposal to issue a Marine Mammal Protection Act (MMPA) Letter of Authorization (LOA); and USCG's proposal to issue a Private Aid to Navigation (PATON) Authorization.

2.1 Action Agencies and Regulatory Authorities

As noted, BOEM has the authority to issue leases, easements, and ROW on the OCS for renewable energy development and has responsibility for determining whether to approve, approve with modifications, or disapprove SouthCoast Wind's COP. Other action agencies associated with approval of the COP include BSEE (Section 2.1.1), USACE (Section 2.1.2), USCG (Section 2.1.3), USEPA (Section 2.1.4), and NMFS (Section 2.1.5). The action agencies are proposing to issue permits or authorizations for activities related to the Proposed Action.

2.1.1 Bureau of Safety and Environmental Enforcement

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 and enforcement actions as appropriate, oversee closeout verification efforts, oversee facility removal inspections/monitoring, and oversee bottom clearance confirmation. BSEE, with BOEM, will enforce COP conditions and ESA terms and conditions on the OCS.

2.1.2 U.S. Army Corps of Engineers

Under section 404 of the CWA, USACE regulates the discharge of dredged or fill material into the waters of the United States. The USACE's section 404 jurisdiction in tidal waters extends from the high tide line to the seaward limits of the territorial seas. The limit of jurisdiction in the territorial seas is measured from the baseline in a seaward direction a distance of three nautical miles (see 33 CFR §§ 328.4(a) & (b)). Under Section 10 of the RHA, USACE regulates construction of any structures and work that are located in or that affect "navigable waters of the U.S." In tidal waters, the shoreward limit of navigable waters extends to the mean high water mark while the seaward limit coincides with the limit of the territorial seas. The USACE's authority to prevent obstructions to navigation in navigable waters of the United

States was extended to artificial islands, installations, and other devices located on the seafloor, to the seaward limit of the outer continental shelf (OCS), by section 4(f) of the Outer Continental Shelf Lands Act of 1953 as amended (43 U.S.C. 1333 and 33 CFR 320.2). Activities subject to USACE jurisdiction include construction of the offshore wind turbine generators (WTGs), scour protection around the base of the WTGs, offshore substation platforms (OSPs), interarray cables, offshore export cables, dredging and other activities, as well as the installation of onshore cables through waters of the U.S., including wetlands.

SouthCoast Wind has applied for authorization from USACE to construct up to 147 offshore WTGs, scour protection around the base of the WTGs, up to five OSPs, interarray cables connecting the WTGs to the OSPs, and offshore export cables. SouthCoast Wind submitted their permit application to USACE on December 2, 2022, and it was deemed complete on February 2, 2023 (USACE file number NAE-2020-00958). BOEM and BSEE will enforce COP conditions and ESA terms and conditions on the OCS. USACE will enforce ESA terms and conditions from the high tide line to the limits of the territorial seas.

2.1.3 U.S. Coast Guard

The USCG administers the permits for PATONs located on structures positioned in or near navigable waters of the United States. PATONS and federal aids to navigation—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, OSPs, and along the offshore export cable corridor (ECC) may be required. These aids serve as a visual reference to support safe maritime navigation. SouthCoast Wind will submit requests for up to 149 PATONs from the USCG, one for each of the WTG or OSP positions, approximately 3 to 6 months prior to offshore construction.

All Project vessels will also be required to comply with existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025).

2.1.4 Environmental Protection Agency

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 Section 328 of the Clean Air Act (42 U.S.C. 7401 et seq.). USEPA issues OCS Air Permits. Emissions from Project activities on the OCS would be permitted as part of an OCS air permit and must demonstrate compliance with National Ambient Air Quality Standards. SouthCoast Wind submitted an application to USEPA for the OCS Air Permit on November 23, 2022 and a revised application in April 2023.

USEPA is proposing to issue one or more NPDES permits under the Clean Water Act for discharge of water into U.S. federal waters. SouthCoast Wind submitted an application to USEPA for a NPDES permit on October 31, 2022 and filed a revised application in August 2023. The NPDES permit application is for discharge from a cooling water intake structure (CWIS) for one high voltage direct current (HVDC) converter station located at an OSP in the Lease Area. USEPA deemed the NPDES permit application complete on September 29, 2023. If SouthCoast Wind selects an additional HVDC converter OSP with a CWIS, which is its preference, SouthCoast Wind would need to apply for an additional NPDES permits(s).

2.1.5 National Marine Fisheries Service Office of Protected Resources

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. Incidental take is defined under the MMPA (50 CFR 216.3) as, “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."

NMFS received a request for authorization to incidentally take marine mammals resulting from construction activities related to the Project, which NMFS may authorize under the MMPA. NMFS's issuance of an MMPA incidental take authorization is a major federal action and, in relation to BOEM's action, is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of SouthCoast Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate SouthCoast Wind's request under requirements of the MMPA (16 U.S.C. 1371(a)(5)(D)) and its implementing regulations administered by NMFS and to decide whether to issue the authorization.

On March 18, 2022, SouthCoast Wind submitted a request for a rulemaking and LOA pursuant to Section 101(a)(5) of the MMPA and 50 CFR part 216 subpart I to allow for the incidental harassment of marine mammals resulting from the installation of WTGs and OSPs; potential detonations of unexploded ordnance (UXO); and performance of high-resolution geophysical (HRG) surveys. SouthCoast Wind is including activities in the LOA request that could cause acoustic disturbance to marine mammals during construction of the Project pursuant to 50 CFR 216.104. The application was reviewed and considered complete on September 19, 2022. NMFS published a Notice of Receipt in the *Federal Register* on October 17, 2022. Between March 2023 and March 2024, SouthCoast Wind submitted to NMFS four revised versions of the LOA application, three versions of a *North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving* (SouthCoast Wind 2024), and two versions of the revised Acoustic Modeling Report (Limpert et al. 2024) in support of the LOA application. These revisions were related to reducing the risk of potential impacts on North Atlantic right whale (NARW) and other marine mammals.

3. Description of the Proposed Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the U.S. or upon the high seas (50 CFR 402.02). The Proposed Action addressed in this BA covers the construction, O&M, and decommissioning of the SouthCoast Wind Project. The Lease Area (OCS-A 0521) is sited 26 nautical miles (48 kilometers) south of Martha's Vineyard and 20 nautical miles (37 kilometers) south of Nantucket, Massachusetts, in the Massachusetts WEA. The Proposed Action would consist of up to 149 structure positions to be occupied by up to 147 WTGs and up to 5 OSPs connected by interarray cables within the Lease Area. The 149 positions will conform to a spacing of a 1.0 nautical mile x 1.0 nautical mile (1.9 kilometer x 1.9 kilometer) grid layout with an east-west and north-south orientation across the entire WEA. The Proposed Action includes one preferred ECC making landfall and interconnecting at Brayton Point, in Somerset, Massachusetts with an intermediate landfall on Aquidneck Island, Rhode Island and one variant ECC which, if utilized, would make landfall and interconnect in the town of Falmouth, Massachusetts. The Proposed Action will be developed in two phases or projects, Project 1 and Project 2. The Brayton Point ECC will be used for both Project 1 and Project 2 while the variant Falmouth ECC will only be used for Project 2 in the event that technical, logistical, grid interconnection, or other unforeseen challenges arise during the design and engineering phase that prevent Project 2 from making interconnection at Brayton Point.

Before a lessee may build an offshore wind energy facility on their commercial wind lease, they must submit a COP for review and approval by BOEM (see 30 CFR 585.620 to 585.638). Pursuant to 30 CFR 585.626, the COP must include a description of all planned facilities, including onshore and support facilities, as well as anticipated easement needs for the Proposed Action. It must also describe all activities related to Proposed Action construction, commercial operations, maintenance, decommissioning, and site clearance procedures. There are benefits to allowing lessees to describe a reasonable range of designs in a COP, because of the complexity, the unpredictability of the environment in which it will be constructed, and the rapid pace of technological development within the industry. In the renewable energy industry, a permit application or plan that describes a reasonable range of designs is referred to as a Project Design Envelope (PDE) approach.

BOEM gives offshore renewable energy lessees the option to use a PDE approach when submitting a COP (see Action 2.1.3 *in* USDOE and USDOI, 2016). A PDE approach is a permitting approach that allows a proponent the option to submit a reasonable range of design parameters within its permit application, allows a permitting agency to then analyze the maximum impacts that could occur from the range of design parameters, and may result in the approval of a proposed action that is constructed within that range.

SouthCoast Wind has elected to use a PDE approach for describing the Proposed Action consistent with BOEM policy. Therefore, this BA and associated ESA consultation are expected to address the full scope of the Proposed Action that may be authorized by BOEM in the record of decision (ROD) and approval of the COP as well as authorized or permitted by the other action agencies. Construction, O&M, and decommissioning activities are described in Section 3.1.2, *Description of Activities*. The impact-producing factors (IPFs) associated with these activities are described in Section 3.2, *Description of IPFs*, and mitigation measures included in the Proposed Action are described in Section 3.3, *Proposed Mitigation, Monitoring, and Reporting Measures*.

3.1 Action Area and Description of Activities Proposed for COP Approval

3.1.1 Action Area

The Action Area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02) and also encompasses the effects of the action, which "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 but that are not part of the action" (50 CFR 402.02). The Action Area for the Proposed Action encompasses all areas to be directly or indirectly affected by construction, O&M, and decommissioning of the SouthCoast Wind Project, including the Project area, defined below, as well as vessel transit routes between the Project area and ports used for Project activities, and areas affected by noise, electromagnetic field (EMF), water quality, benthic, and other impacts associated with the Proposed Action. This Action Area encompasses all effects of the Proposed Action considered here.

For purposes of this BA, the Project area is considered the portion of the Action Area where construction and eventual O&M of the Proposed Action will take place. The Project area, therefore, encompasses the Lease Area, including all WTG and OSP foundations and interarray cable routes, and the export cable routes from the OSPs to shore (Figure 3.1-1).

Although the majority of activities associated with the Proposed Action would occur in the Project area, Project vessels would travel between the Project area and ports. Table 3.1-1 identifies the ports that may be used during construction, O&M, and decommissioning. The Action Area includes any vessel routes between these port locations and the Project area. Currently, multiple ports are under consideration for specific vessel types. Final port selection may result in a single selected port for a specific vessel type or a combination of multiple selected ports for a specific vessel type. The ports under consideration are based on feedback provided to SouthCoast Wind by U.S. and international supply chain vendors, transport and installation vendors, and the availability and/or port capability to accommodate vessels needed to build the windfarm in accordance with applicable U.S. laws. While specific ports have not been identified where equipment and components may originate, SouthCoast Wind anticipates Project components (e.g., WTG monopile and OSP foundations, export cables, etc.) could be fabricated in the Americas, Europe, Asia, and/or the Middle East and then delivered directly to the OCS site. Some Project components, such as WTG components, would first be shipped to a port in the U.S. or Canada for marshalling due to staging requirements before transiting to the Project area. Marshalling ports are those closest to the Project area in Massachusetts, Rhode Island, and/or Connecticut (Table 3.1-1).

All vessel routes will depend, on a trip-by-trip basis, on weather and sea-state conditions, other vessel traffic, and any maritime hazards. BOEM assumes that vessels traveling from international ports of origin to the Project area or marshalling ports will take the most direct route; thus, BOEM considers the Action Area to include portions of the North Atlantic Ocean, Caribbean Sea, and Gulf of Mexico where project vessels transiting from international or domestic ports may operate. However, the bulk of the analysis herein focuses on the higher likelihood of interactions between ESA species and Project activities in waters nearest the Project area. Entry points into the U.S. for vessels transiting from international ports directly to the Lease Area are depicted in Figure 3.1-2.

Table 3.1-1. Potential Proposed Action ports and average transit distance between ports and the Lease Area

Ports	Distance (nautical miles) to Lease Area[2]
Port of New Bedford, Massachusetts, USA	70
Port of Davisville, Rhode Island, USA	75
Port of Providence, Rhode Island, USA	85
Port of New London, Connecticut, USA	90
Port of Fall River area, Massachusetts, USA	95
Port of Salem, Massachusetts, USA	170
Sparrows Point Port, Maryland, USA[1]	490
Port of Charleston, South Carolina, USA[1]	690
Port of Corpus Christi, Texas, USA[1]	2301
Port of Altamira, Tamaulipas, MEX[1]	2167
Entry Point into U.S. Waters, vessels transiting from	
Canada (includes Sheet Harbor, Port of Sydney, Port of Argentia)	169
Panama Canal[1]	170
Europe & Asia	216

[1] Indicates low likelihood and/or minimal use of ports.
[2] Distances are based on the linear distance along typical navigation routes from the ports to the Lease Area.

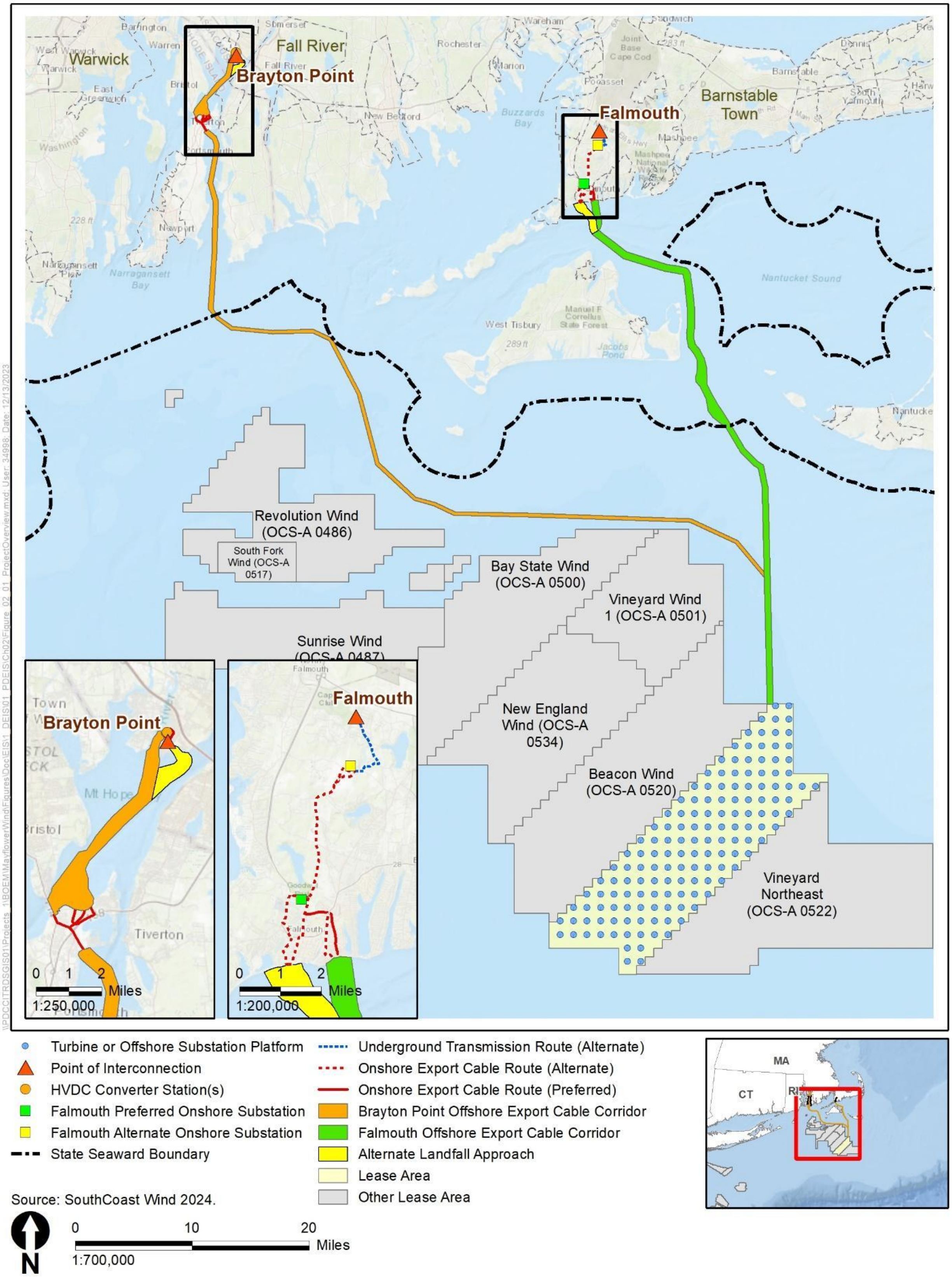
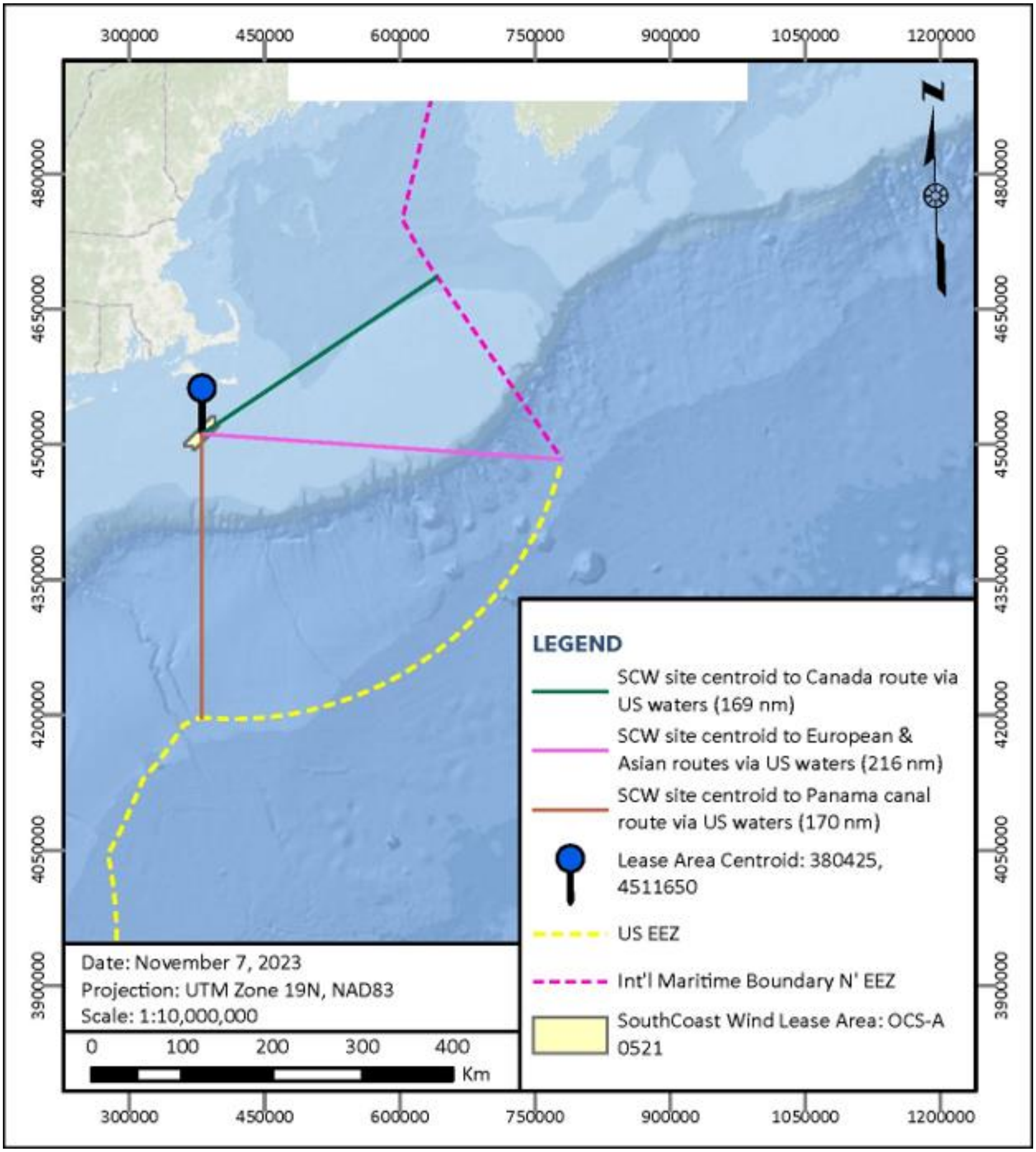


Figure 3.1-1. Project area



SCW = SouthCoast Wind, EEZ = Exclusive Economic Zone, Int'l = International

Figure 3.1-2. Entry point into U.S. for vessel trips transiting from international ports directly to the Lease Area

3.1.2 Description of Activities

Activities considered in this BA include offshore, nearshore, and onshore/upland activities during the construction, O&M, and decommissioning phases of the Proposed Action. The construction, O&M, and decommissioning of the Project would result in impacts on aquatic species in the nearshore and offshore waters of the southern New England OCS. Offshore activities for the construction of the Proposed Action would include installation of WTGs and OSPs, including their foundations, installation of interarray and export cables, and pre- and post-construction surveys. Nearshore activities for the Proposed Action would include sea-to-shore transition cabling at landfall locations and pre- and post-construction surveys. Upland activities for the construction of the Proposed Action would include installation of onshore cables and onshore converter stations and/or substation. A description of onshore cable construction is provided in Section 3.1.2.4.4; however, the effects from upland activities are not analyzed in this BA as they are not anticipated to result in impacts on aquatic species in nearshore and offshore waters under NMFS jurisdiction. As noted, SouthCoast Wind has elected to use a PDE approach for the Proposed Action, which is reflected in the description of the activities in this BA. For the purpose of this ESA consultation, BOEM assumes that the Applicant may select the design alternative within the PDE resulting in the greatest potential impact to the environment.

Maximum PDE parameters for the SouthCoast Wind project are summarized in Table 3.1-2 and the general construction schedule is provided in Table 3.1-3 for onshore and offshore components and in Figure 3.1-3 for offshore activities. The SouthCoast Wind Lease Area will be developed in two phases or "projects". Project 1 refers to the development in the northern portion of the Lease Area and associated interconnection, and Project 2 refers to the development in the southern portion of the Lease Area and associated interconnection. Figure 3.1-3, taken from SouthCoast Wind's Incidental Take Regulations (ITR) Application to NMFS, depicts nominal installation periods for the major offshore Project components for Projects 1 and 2.

The lengths of each Project phase are as follows:

- Construction (onshore and offshore): approximately 7 years (Project 1 and Project 2 combined);
- Operations and Maintenance (O&M): approximately 35 years[2]; and
- Decommissioning: unless otherwise authorized by BOEM, pursuant to the applicable regulations in 30 CFR Part 585, SouthCoast Wind would be required to remove or dispose of all facilities within 2 years following termination of SouthCoast Wind's lease.

In May 2023, SouthCoast Wind informed BOEM that it was removing gravity-based structures (GBS) as a potential foundation from its PDE (from both Project 1 and Project 2) and that it would restrict possible locations of suction-bucket jacket foundations to the southern portion of the Lease Area corresponding to Project 2.

The construction schedule (Figure 3.1-3) shows potential foundation installations occurring in more than one year for each project (Project 1 and Project 2) because the specific period in which foundation installations will commence is not currently known; however, it is expected that foundation installations would occur in a single year for each project. During the construction and installation period, some activities will occur 24-hours a day in order to minimize the overall duration of activities and the associated period of potential impact on marine mammals. This may include impact and/or vibratory pile

[2] SouthCoast Wind's lease with BOEM (Lease OCS-A 0521) has an operational term of 33 years that commences on the date of COP approval. (https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Lease-OCS-A-0521.pdf; see also 30 CFR 585.235(a)(3).) SouthCoast Wind would need to request an extension of its operational term from BOEM in order to operate the proposed Project for 35 years. The BA analyzes a 35-year operational term in case BOEM grants such an extension and for the purposes of maximum-case scenario.

driving of WTG and OSP foundations during nighttime hours. The total number of construction days will be dependent on a number of factors, including environmental conditions, planning, construction, and installation logistics.

O&M of offshore wind facilities would result in impacts on aquatic species in the nearshore and offshore waters of the New England OCS associated with aquatic activities. Additional information about Project O&M requirements is provided in the COP (SouthCoast Wind 2023). Decommissioning activities, described in Section 3.1.2.9, *Decommissioning*, are expected to result in similar, or lesser, impacts on ESA-listed species as construction activities.

Table 3.1-2. SouthCoast Wind Project Design Envelope summary

Project Component	Location	Project Details and Envelope Characteristic(s)
Layout and Project Size	Offshore	• Up to 149 WTG/OSP positions • Up to 147 WTGs • Up to 5 OSPs • 1 nautical mile x 1 nautical mile (1.9 kilometer x 1.9 kilometer) grid layout with east-west and north-south orientation

Foundations	Offshore	• Monopile, piled jacket, and/or suction-bucket jacket for WTGs OSPs (maximum 85 suction-bucket jacket foundation locations for Project 2 only)
		• Seabed penetration: 65.6–262.4 feet (20.0–80.0 meters)
		• Foundation diameters
		  ○ monopiles: up to 52.5 feet (16.0 meters)
		  ○ piled jackets: up to 14.7 feet (4.5 meters)
		  ○ suction-bucket jackets: up to 65.6 feet (20.0 meters)
		• Scour protection for up to all positions

WTGs	Offshore	• Rotor diameter: 721.7–918.6 feet (220.0–280.0 meters) • Blade length of 351.0–452.8 feet (107.0–138.0 meters) • Hub height above MLLW: 418.7–605.1 feet (127.6–184.4 meters) • Total coolant: 73,500 gallons (from up to 147 WTGs) • Total oils and lubricants: 433,650 gallons (from up to 147 WTGs) • Total diesel fuel: 132,300 gallons (from up to 147 WTGs) • Gas insulated equipment will use Sulfur hexafluoride (SF6)
OSPs	Offshore	• Maximum structures envisaged located on grid positions: 5 • HVAC and HVDC converter OSP options • Top of topside height above MLLW: 160.8–344.5 feet (49.0–105.0 meters) • Scour protection for all positions • Total coolant: 1,500 gallons (from up to 5 OSPs) • Total oils and lubricants: 755,000 gallons (from up to 5 OSPs) • Total diesel fuel: 200,000 gallons (from up to 5 OSPs) • Gas insulated equipment will use Sulfur hexafluoride (SF6)
Interarray Cables	Offshore	• Nominal interarray cable voltage: 60 to 72.5 kV • Length of interarray cables beneath seafloor: Up to 497.1 miles (800 kilometers) • Target burial depth (below level seabed): 6 feet (1.8 meters) • Possible burial depth range (below level seabed): 3.2–8.2 feet (1.0–2.5 meters)

Project Component	Location	Project Details and Envelope Characteristic(s)
Brayton Point Offshore Export Cables	Offshore, Nearshore	• Number of offshore export cables: up to 6 • Nominal export cable voltage (DC): ±320 kV • Length per export cable beneath seabed: Up to 124 miles (200 kilometers) • Cable/pipeline crossings: up to 16 • Target burial depth (below level seabed): 6 feet (1.8 meters) • Possible burial depth range (below level seabed): 3.2–13.1 feet (1.0–4.0 meters)
Aquidneck Island Onshore Export Cable Route (Intermediate landfall)	Nearshore, Onshore	• Portsmouth, Rhode Island • Nominal underground onshore export cable voltage for DC transmission: ±320 kV • Up to 4 onshore export cables and up to 2 communications cables • Up to 3 miles (4.8 kilometers) per cable
Falmouth Offshore Export Cables[1]	Offshore, Nearshore	• Number of offshore export cables: up to 5 • Anticipated nominal export cable voltage (AC or DC): 200–345 kV (AC) or ±525 kV (DC) • Length per export cable beneath seabed: Up to 87.0 miles (140.0 kilometers) • Cable/pipeline crossings: up to 9 • Target burial depth (below level seabed): 6 feet (1.8 meters) • Possible burial depth range (below level seabed): 3.2–13.1 feet (1.0–4.0 meters)
Brayton Point Landfall Site	Nearshore, Onshore	• Brayton Point: Two locations under consideration: Eastern and Western shorelines of Brayton Point • Brayton Point: Installation methodology: HDD • Aquidneck Island: Several locations under consideration for the intermediate landfall across the island • Aquidneck Island: Installation methodology: HDD
Falmouth Landfall Site[1]	Nearshore, Onshore	• Three locations under consideration: Worcester Avenue, Central Park, and Shore Street • Installation methodology: HDD
Onshore Export Cables from Landfall to HVDC Converter Station	Onshore	• Somerset, Massachusetts • Nominal underground onshore export cable voltage for DC transmission: ±320 kV • Up to 6 onshore export cables and up to 2 communications cables • Up to 0.6 mile (1.0 kilometer) per cable
Onshore Export Cables from Landfall to Onshore Substation[1]	Onshore	• Falmouth, Massachusetts • Nominal underground onshore export cable voltage for AC transmission: 200–345 kV • Up to 12 onshore export power cables and up to 5 communications cables • Up to 6.4 miles (10.3 kilometers) per cable
HVDC Converter Stations	Onshore	• Somerset, Massachusetts • Up to two HVDC converter stations • Up to 7.5 acres (3 hectares) • Convert the power from DC to 345 kV AC for injection to the existing ISO-NE grid system

Project Component	Location	Project Details and Envelope Characteristic(s)
Onshore Substation[1]	Onshore	• Falmouth, Massachusetts • Two locations under consideration: Lawrence Lynch and Cape Cod Aggregates • Up to 26 acres (10.5 hectares) for the substation yard • Transform to 345 kV • Air-insulated substation or gas-insulated substation configurations
Transmission Line from Onshore Substation to Falmouth POI[1]	Onshore	• Falmouth, Massachusetts • New 345-kV overhead transmission line along existing utility ROW (preferred) • To be designed, permitted, constructed, and operated by transmission system owner, Eversource • New, 345-kV underground transmission line (alternate) • Up to 2.1 miles (3.4 kilometers) in length
Transmission Line from HVDC Converter Stations to Brayton Point POI	Onshore	• Somerset, Massachusetts • New, 345-kV underground transmission line • Up to 0.2 mile (0.3 kilometer) in length
Falmouth POI[1]	Onshore	• Falmouth, Massachusetts • Upgrades to existing Falmouth Tap (new or upgraded POI by Eversource)
Brayton Point POI	Onshore	• Somerset, Massachusetts • Existing, National Grid substation 345-kV gas-insulated switchgear breaker building at National Grid substation

Source: COP Volume 1, Table 3-1; SouthCoast Wind 2023
AC = alternating current; DC = direct current; HDD = horizontal directional drilling; HVAC = high-voltage alternating current; HVDC = high-voltage direct current; kV = kilovolt; MLLW = mean lower low water; POI = point of interconnection
[1] If Falmouth is the selected POI for Project 2.

Table 3.1-3. SouthCoast Wind Project schedule summary (onshore and offshore)

Construction Activity	SouthCoast Wind Indicative Construction Schedule
HVDC – Onshore Scope	Q1 of 2025 to Q2 of 2029
HVDC – Fabrication/Installation and Commissioning	Q2 of 2026 to Q4 of 2030
Foundations/Substructures – Scour Protection and Seabed Preparation	Q1 of 2027 to Q3 of 2029
Foundations/Substructures – Substructure Installation – Piled Jackets/Monopiles	Q2 of 2028 to Q4 of 2030
Foundations/Substructures – Substructure Installation – Suction Bucket Jacket	Q2 of 2030 to Q3 of 2031
Interarray Cable – Installation and Commissioning	Q2 of 2028 to Q3 of 2030
Export Cable – Install – Onshore, Offshore, and Commissioning	Q4 of 2026 to Q3 of 2030
WTG – Installation and Commissioning	Q2 of 2029 to Q4 of 2031

Source: COP Volume 1, Figure 3-6; SouthCoast Wind 2023.
Q = quarter

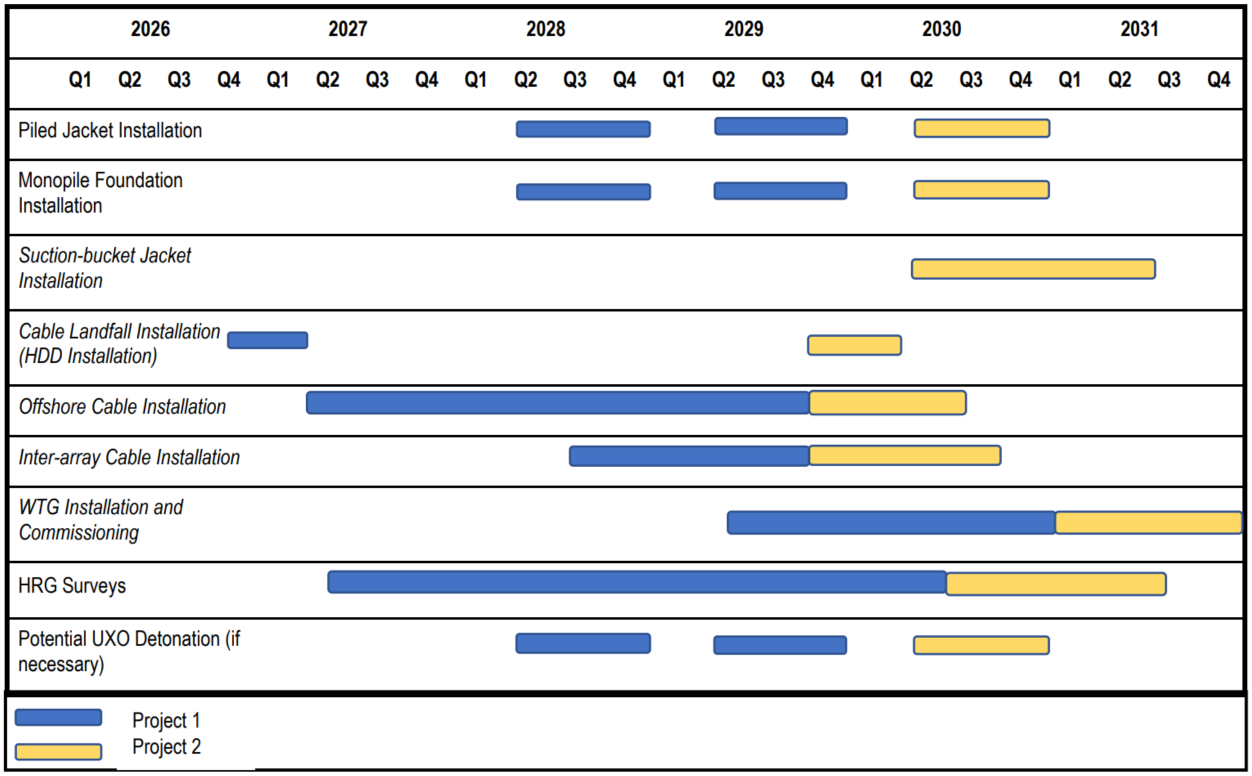


Figure 3.1-3. SouthCoast Wind indicative construction schedule (offshore)

Source: LGL 2024 SouthCoast Wind Construction ITR Application
Note: Project 1 refers to the development in the northern portion of the Lease Area and associated interconnection (Brayton Point), and Project 2 refers to the development in the southern portion of the Lease Area and associated interconnection (Brayton Point or Falmouth).

3.1.2.1 Wind Turbine Generators

3.1.2.1.1 Description

The proposed Project would use WTGs designed to operate in offshore conditions specific to the Lease Area. The Proposed Action includes installation and operation of up to 147 WTGs. Each WTG would extend up to 1,066 feet (325 meters) above mean lower low water (MLLW). Spacing between the WTGs would be 1 nautical mile (1.9 kilometers) within the Lease Area. The main components of the WTG include the nacelle, the rotor, three blades, and the tower. The rotor transfers rotational energy to the nacelle through the main shaft. The nacelle contains the vital components of the WTG including the generator, transformers, converter, and additional subsystems necessary to generate electricity and control WTG functionality. The nacelle would be positioned on a multi-sectional tower attached to a transition piece or foundation depending on the foundation design selected. Foundations under consideration for the WTGs are described in Section 3.1.2.3, *Foundations*. The exact WTG type and supplier have not been finalized, and SouthCoast Wind is currently considering the use of both direct drive and gear-driven turbines.

Each WTG would contain oils, greases, and fuels used for lubrication, cooling, and hydraulic transmission. Indicative volumes are listed in Table 3.1-2. Final quantities will be dependent upon final component selection. The WTGs would be designed to minimize the potential for spills. At the end of their operational life, these fluids would be disposed of according to applicable regulations and guidelines.

3.1.2.1.2 Operation and Maintenance

Planned maintenance activities involve inspecting components and equipment that are commonly known to need replacement for signs of wear and tear in accordance with the WTG supplier's specified maintenance schedule. Statutory inspections of WTGs' safety and electrical equipment would occur in conformance with all applicable regulations. Unplanned maintenance may involve responding to an unplanned outage or equipment failure. This may require the use of a jack-up vessel or transportation vessel to carry, install, and/or repair the failure in question. Table 3.1-4 lists the primary maintenance activities along with the potential frequency of visits.

Table 3.1-4. Indicative O&M WTG task and schedule

O&M Task	Inspection Cycle
Planned annual maintenance	Annually
Routine maintenance and regulatory inspection including lifesaving equipment	Annually
Blade inspections (may be inspected by drone)	Every 1 to 3 years
Hydraulic oil change per WTG on average	Every 10 years
Gear oil change per WTG (not applicable to direct drive)	Every 6 to 10 years
Unplanned maintenance	As needed
Approximate visits for unscheduled maintenance	Annually

O&M = operations and maintenance; WTG = wind turbine generator
Source: COP Volume 1, Table 3-9; SouthCoast Wind 2023.

During O&M, SouthCoast Wind will utilize lighting during operations as required by the USCG, FAA, and/or relevant regulatory body and abide by all applicable standards. This includes lighting to be placed on all offshore structures that will be visible throughout a 360-degree arc to aid in mariner navigation. SouthCoast Wind will implement an Aircraft Detection Lighting System (ADLS), which will activate the lighting system on WTGs based on approaching air traffic. SouthCoast Wind does not anticipate utilizing continuous lighting on the WTGs at the water's surface; however, SouthCoast Wind does plan to illuminate, at a minimum, the landing during crew transfers (specifically, the Walk to Work gate). The gangway from operations vessels will be fitted with necessary lighting that meets minimum requirements to assure safe transfers of technicians.

3.1.2.2 Offshore Substation Platforms

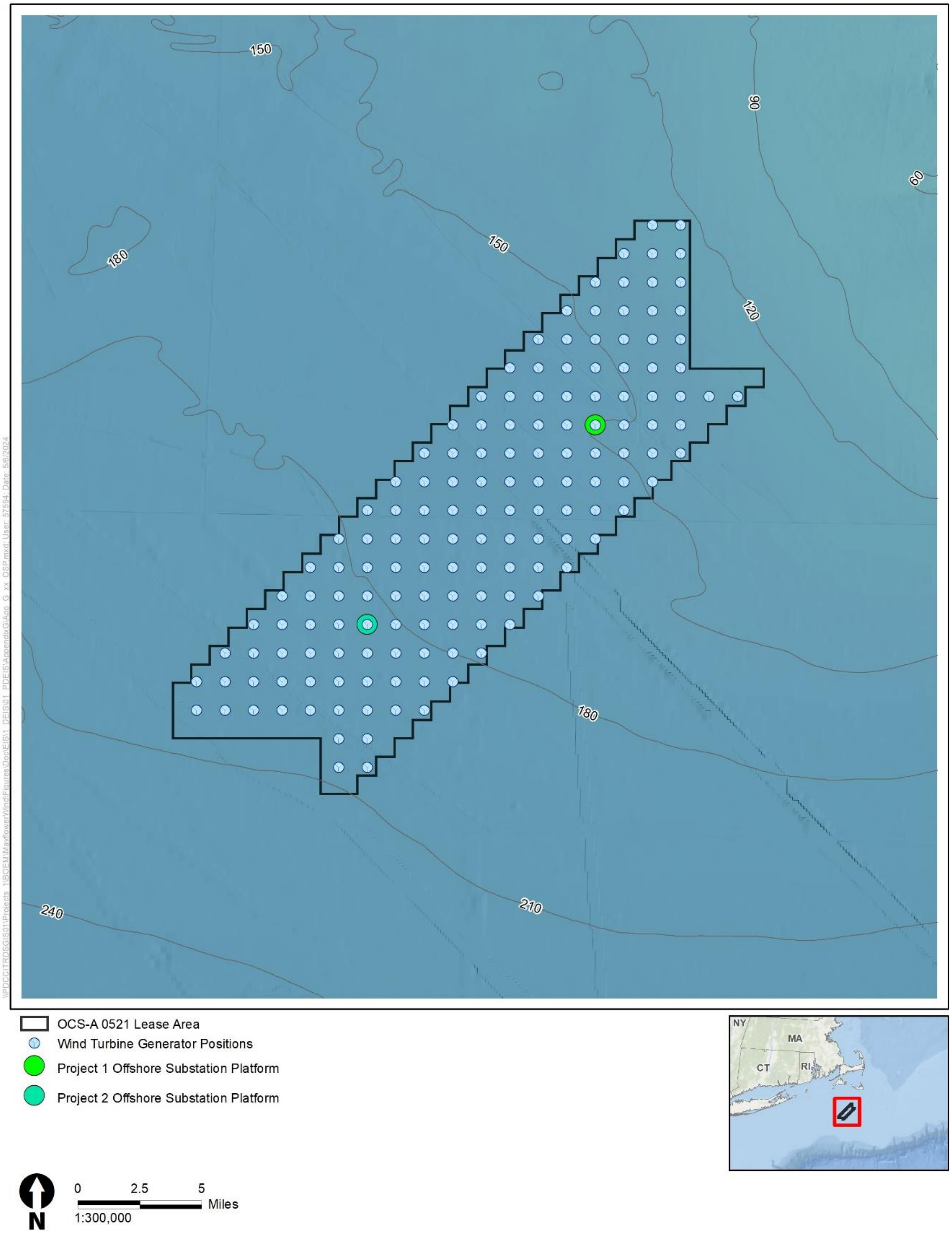
3.1.2.2.1 Description

The proposed Project would include up to five OSPs to collect the energy generated by the WTGs and would be located on the same 1 nautical mile x 1 nautical mile (1.9 kilometer x 1.9 kilometer) grid layout as the WTGs. OSPs help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. Three OSP designs are under consideration: Option A – Modular, Option B – Integrated, Option C – HVDC Converter. Each OSP design would include a topside that houses electrical equipment and a foundation substructure to support the topside. Foundations under consideration for the OSPs are described in greater detail in Section 3.1.2.3. The smallest topside structure would be Option A – Modular and would likely hold a single alternating current (AC) transformer with a single export cable. It would sit on any type of substructure design considered for the WTGs (monopile, piled jacket, or suction-bucket jacket). Option B – Integrated is also an AC solution but is designed to support a high number of inter-array cable connections, as well as multiple export cable connections and would contain multiple transformers in a single topside structure. Depending on the weight of the topside structure and soil conditions, the jacket substructure may be four- or six-legged and require one to three piles per leg. Because of its larger size, if Option B is selected, a smaller number of OSPs would be required to support the proposed Project. Option C – HVDC Converter would convert electric power from HVAC to HVDC for transmission to the onshore grid system and would serve as a gathering platform for inter-array cables or be connected to one or more HVAC gathering units, which would be similar to the Modular and Integrated OSP designs. Due to its size, the HVDC Converter OSP would be installed on piled jacket foundation. SouthCoast Wind's preferred OSP design is Option C – HVDC Converter with piled jacket foundations to meet the specific engineering requirements of this design.

While the PDE includes up to five OSPs, SouthCoast Wind's preference and the most likely scenario is two HVDC OSPs, one for Project 1 (Brayton Point) and one for Project 2 (Brayton Point or Falmouth). SouthCoast Wind has already selected an HVDC converter OSP (Option C) for Project 1. For Project 2, SouthCoast Wind will select an OSP design based on future offtake agreements and through its supplier/equipment contracting process. If HVDC is selected for Project 2, which is the most likely scenario, there would be one HVDC OSP for Project 2 in addition to the HVDC OSP for Project 1 (for a total of two HVDC OSPs). While not SouthCoast Wind's preference, if HVAC is selected for Project 2, SouthCoast Wind anticipates there would be one HVAC OSP for Project 2 in addition to the HVDC OSP for Project 1 (for a total of two OSPs).

SouthCoast Wind filed a NPDES permit application for the HVDC converter OSP for Project 1 on October 31, 2022 and submitted a revised application in August 2023. A copy of the NPDES permit application is provided as Appendix A, *SouthCoast Wind National Pollutant Discharge Elimination System Permit Application* of this BA (Tetra Tech and Normandeau Associates, Inc. 2023). If SouthCoast Wind uses HVDC technology for Project 2, the parameters and modeling results from the NPDES permit application are representative of a second HVDC converter OSP for Project 2 within the Lease Area. Currently, the only major anticipated difference would be the location of the second HVDC converter OSP, which would be at a deeper position in the southern portion of the Lease Area. Neither HVDC converter OSP would be placed in the enhanced mitigation area near Nantucket Shoals, in alignment with the NS-1 mitigation measure (see Section 3.3, Table 3.3-2).

Figure 3.1-4 shows the indicative location of the HVDC converter OSP for Project 1 (Latitude = 40° 48' 18.16" N, Longitude = -70° 19' 29.41" W) and Project 2 (Latitude = 40° 40' 34.81" N, Longitude = -70° 28' 41.60" W). The HVDC converter OSP would include a CWIS, requiring the use of up to 9.9 million gallons per day (MGD) of once-through non-contact cooling water at a maximum intake velocity of 0.5 feet (0.2 meter) per second, discharged to a vertical pipe attached to the OSP foundation. Seawater intake pipes are fitted with an in-built pump strainer with a typical outer screen size of 3/8 inches (9.5 millimeters) intended to protect the seawater lift pump impeller from debris in the water column. Each OSP pump flowline is also equipped with a dedicated filter (typical mesh size of 250 micrometers), intended to protect the equipment and ensure reliable operation of the CWIS. Discharged effluent is estimated to have a maximum temperature of approximately 86°F (30°C). Hypochlorite solution is used as an antifouling agent at concentrations of 0 to 2 parts per million in the seawater intake lines. Residual free chlorine within the effluent would be negligible and oxidized in the water with no negative impact. Table 3.1-5 lists parameters of the CWIS system. The NPDES permit application in Appendix A includes additional details on the HVDC converter OSP design and a discussion of potential effects, including impingement/entrainment and thermal plumes, which are assessed in detail in Section 5, *Effects of the Proposed Action*.



Source: TetraTech and Normandeau Associates, Inc. 2023 with supplemental data provided by SouthCoast Wind

Figure 3.1-4. Indicative Location of HVDC converter OSP for Project 1 and Project 2

Table 3.1-5. CWIS parameters for one HVDC converter OSP

Configuration Parameter	HVDC Converter OSP CWIS
Source water	Atlantic Ocean
CWIS	Non-contact, once-through cooling. Each of the three intakes pipes (caissons) operates independently with its own seawater lift pump. No common entrance or shared piping between each intake caisson. Typical operations utilize no more than two seawater lift pumps, with the third serving only as a backup to the other two pumps (no operating scenario will utilize three seawater lift pumps simultaneously).
Configuration of intake	Three, approximately 28-inch (0.7-meter)-diameter vertical-shaft intake caissons, with flared ends to accommodate intake velocity requirements, set perpendicular to the seafloor, in the middle portion of the water column, located within the jacketed foundation structure. • The three intake caissons on the OSP are separated by approximately 3.3 feet (1 meter) distance from each other, with the first caisson located approximately 91.9 feet (28 meters) distance from the center of the platform coordinates. Note that the three intake caissons are independently operating structures with no common intake or entrance.
Configuration of discharge	The cooling water discharge includes one 36-inch (0.91-meter)-diameter vertical-shaft discharge caisson, located in the middle portion of the water column, and set perpendicular to the seafloor, located within the jacketed foundation structure. The discharge depth is 42.7 feet (13 meters) below the surface and the location of discharge is within a 20-meter radius from the center of the platform coordinates. This location/depth ensures sufficient distance is maintained between the lift pump caisson and the overboard water caisson.
Trash/debris bar rack	The intake caisson(s) will be equipped with a stainless steel trash or debris bar rack. The proposed bar rack will be similar in concept and analogous to a turtle exclusion device (TED), utilized by some commercial fisheries to prevent sea turtles from becoming entrapped within a trawl net; in this case the bar rack would exclude large marine organisms from entering the intake caisson. The bar rack will consist of three stainless steel bars approximately 0.8 inches (20 millimeters) wide, or similar, fixed to the bell mouth opening of the intake caisson. SouthCoast Wind will require the bar rack to be incorporated into the specific design elements of the OSP fabricator. However, the use of trash or debris bar racks is not optimal for a seawater lift pump caisson installed in an offshore environment. The use of a bar rack at the intake of the pump caisson will create maintenance concerns over time; the bar rack will biofoul with encrusting/fouling organisms and will require direct access to the pump caisson intake periodically for cleaning campaigns. The original design did not include a bar rack for this reason, but a bar rack will be added for compliance requirements of the NPDES permit application. SouthCoast Wind is considering a range of 6 to 10 inch (15.2 to 25.4 cm) spacing between bars[1]. The configuration details will be refined during the detailed design stage, which will include consultations with USEPA and other agencies to ensure appropriate spacing of bars is protective of marine organisms, as applicable within engineering constraints (e.g., flow velocity, biofouling, etc.).
Pump screens/strainers	Each seawater intake caisson is equipped with an in-built pump strainer with a typical outer screen size of 3/8 inches (9.5 millimeters), intended to protect the seawater lift pump impeller from debris in the water column. The strainers are retractable on the seawater lift pump for cleaning. At deck level 1 of the OSP, each pump flowline is also equipped with a dedicated filter (typical mesh size of 250 micrometers), intended to protect the equipment and ensure reliable operation of the CWIS. The filter is provided with an automated backwash cleaning system; no chemicals are involved in the cleaning cycles

Configuration Parameter	HVDC Converter OSP CWIS
Number of traveling screens/ screen wells	N/A- no traveling screens
Water depth of withdrawal, below surface at MLLW	74 feet (22.6 meters) below the surface
Water depth of withdrawal, above seafloor	81 feet (24.7 meters) above the seafloor
Through-screen velocity (calculated from Design Intake Flow [DIF])	**Intake velocity will not exceed 0.5 feet (0.2 meters) per second** to meet the velocity-based impingement compliance option. A maximum velocity of less than or equal to 0.5 feet (0.2 meters) per second will be integrated into the engineering design of the CWIS to ensure compliance. The intake velocity of 0.5 feet (0.2 meters) per second (or less) will be ensured to be the design limit velocity at the bar rack, accomplished by ensuring the CWIS intake bell mouth diameter is sized in relation to the lift pump maximum flow rate (i.e., determined at the maximum power of the motor driving the pump or the pump curve, whichever is greater) and that the bell mouth face velocity is not exceeding 0.5 feet (0.2 meters) per second. See NPDES permit Section 6.2 (Tetratech and Normandeau Associates Inc., 2023) for intake velocity calculation, based on parameters below, including pump data from a submersible seawater lift pump deployed on another project with a similar cooling duty requirement of 50.16 Btu/h (14.7 megawatts): • Maximum cooling seawater flow required DIF: 9.9 MGD (2 x 780 m^3/h = 1,560 m^3/h), including contingency • Selected pump maximum operational flow (Qmax): (780 m^3/h), based on representative pump data • Typical pump configuration: 2 x up to 50% of operational flow, or 1 x up to 100% of operational flow • Minimum pump flow (Qmin): 1.3 MGD (200 m^3/h) • Minimum pump head (Hmin at Qmax): 160.8 ft (49 m) • Maximum pump head (Hmax at Qmin): 239.5 ft (73 m) • CWIS intake bell mouth diameter: 4.74 ft (1.445 m) • CWIS intake bell mouth area: 17.66 ft2 (1.64 m^2) • CWIS intake velocity (face velocity): < 0.5 ft/s (0.15 m/s)
Seawater lift pumps (intake pumps)	The seawater cooling system is a once-through (open loop) system. The maximum heat duty of the offshore substation platform (OSP) is 50.16 Btu/h (14.7 MW). This maximum heat duty of 50.16 Btu/h (14.7 MW) requires a maximum seawater flow of 9.9 MGD (i.e.,1,560 m3/h, including contingency) for cooling. Up to two raw seawater vertical lift pumps are required to fulfill the cooling duty. Each seawater lift pump has a rated maximum nameplate flow capacity of 900 cubic meters per hour, but maximum operational flow would not exceed 780 cubic meters per hour per pump, resulting in a maximum design intake flow (DIF) of 9.9 MGD, with two pumps operating. Only two of the three pumps would be used under normal operating conditions, with the third pump serving only as a spare/backup. Each seawater lift pump supplies once-through, non-contact cooling water to a plate heat exchanger, to facilitate heat exchange/cooling with the seawater cooling system (of 7.35 megawatt heat duty capacity per heat exchanger). Internal cooling flow is controlled with the use of a 3-way valve while maintaining a constant speed with seawater once-through (open loop) cooling. In addition, a variable frequency drive (VFD) on each of the seawater lift pump motors, to accomplish the following:

<table>
<tr><th>Configuration Parameter</th><th>HVDC Converter OSP CWIS</th></tr>
<tr><td></td><td>

The seawater lift pumps are equipped with VFDs for slow start-up of the seawater supply lines.
Fine-scale control of the flow volume, based on cooling requirements.
In order to prevent freezing of the standby line, a VFD is used to operate the standby seawater lift pump at minimum flow capacity during the winter season (still within the maximum 9.9 MGD DIF for the facility)

</td></tr>
<tr><td>Maximum Discharge Temperature</td><td>86°F (30°C)</td></tr>
<tr><td>Total Design Intake Flow (DIF)</td><td>9.9 MGD = maximum design intake flow required for cooling of the OSP.
Two of the seawater lift pumps operating at approximately 87% of their rated nameplate capacity will provide up to 9.9 MGD (DIF) during normal operating conditions (up to 4.95 MGD each to supply the required cooling water).
During normal operating conditions, each individual seawater lift pump will provide up to 4.95 MGD to ensure reliable, safe operating conditions at the unmanned OSP. Seawater Lift Pump settings can be controlled with or without a variable frequency drive (VFD). Internal cooling flow is controlled by use of a 3-way valve while maintaining a constant speed with the seawater once-through (open loop) cooling. The system is designed for a rated nameplate capacity of each seawater lift pump of 900 m^3/h. However, SouthCoast Wind is seeking 9.9 MGD maximum design intake flow (DIF) in the NPDES permit to align with the expected maximum operational conditions (two pumps operating at up to 780 m^3/h each), as the seawater lift pumps are not designed to operate at 100% of their total rated nameplate capacity to meet the cooling needs of the OSP.</td></tr>
<tr><td>Actual intake flow (AIF)</td><td>The summary below represents expected maximum, average, and minimum flows during operations for each month. However, the actual AIF will be determined based on CWIS conditions, once operational. Per §125.92(a), AIF represents the average volume of water withdrawn on an annual basis by the cooling water intake structures over the past three years. After October 14, 2019, AIF means the average volume of water withdrawn on an annual basis by the cooling water intake structures over the previous five years.
<table>
<tr><th>Month</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Max DIF (MGD)</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td></tr>
<tr><td>Average Intake Flow (MGD)</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td></tr>
<tr><td>Min Intake Flow (MGD)</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td></tr>
</table>
</td></tr>
<tr><td>Flow reduction from design capacity</td><td>While 9.9 MGD is the DIF, a 50% flow reduction potential from DIF could be achieved by use of single-pump operation (4.95 MGD), or dual-pumps each operating at reduced capacity during low-load operating conditions.</td></tr>
<tr><td>Closed-cycle recirculating cooling</td><td>None. Closed-cycle (closed-loop) cooling utilizing air or seawater is not an available technology for this type of unmanned offshore facility</td></tr>
<tr><td>Monitoring parameters and sensor locations</td><td>The three intake structures will include the following instrumentation:

Temperature & water conductivity monitoring devices installed at the seawater lift pump intake.
The intake seawater flowline has an inline flow meter installed upstream of the seawater filter at the topside of the converter station.
Temperature and flow monitoring devices are installed at the feed line and at the discharge outlet of the seawater heat exchanger.

</td></tr>
</table>

Configuration Parameter	HVDC Converter OSP CWIS
	• Mechanical sampling connections located at the return line of seawater. The samples will be taken as required per NPDES permit conditions, to a laboratory for the analysis of required parameters, per the final NPDES permit.
Chlorination system	The CWIS is equipped with an antifouling system to prevent marine growth in the pump caissons and the Seawater System, which consists of Hypochlorite Generator Packages. The Hypochlorite Generator Package produces Sodium Hypochlorite (NaOCl) by seawater electrolysis. The hypochlorite is injected into the pump caissons near the suction level of the Seawater Lift Pumps. Hypochlorite Generator Packages are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 parts per million equivalent free chlorine concentration in the seawater intake lines. This method of continuous injection into the pump caisson is preferred because at a low dosage of NaOCl (i.e., 2 milligrams per liter, 95 kilograms per day), the residual free chlorine at the outlet would be negligible and oxidized in the water with no negative impact.

Source: Tetra Tech and Normandeau Associates, Inc. 2023 with supplemental information provided by SouthCoast Wind.
Btu/h = British thermal unit per hour; CWIS = cooling water intake structure; DIF = Design Intake Flow; °F = degrees Fahrenheit; °C = degrees Celsius; cm = centimeter; ft = feet; ft/s = feet per second; GPM = gallons per minute; m/s = meters per second; m = meter; m^2 = square meter; m^3/h = cubic meter per hour; MLLW = Mean Lower Low Water; MGD = million gallons per day; NaOCl = sodium hypochlorite; NPDES = National Pollutant Discharge Elimination System; OSP = offshore service platform

Each OSP would contain oils, greases, and fuels used for lubrication, cooling, and hydraulic transmission. Indicative volumes are listed in Table 3.1-2. Final quantities will be dependent upon final component selection. At the end of their operational life, these fluids would be disposed of according to applicable regulations and guidelines.

3.1.2.2.2 Operation and Maintenance

During operation, the OSPs would be remotely monitored from an onshore facility through supervisory control and data acquisition systems, which acts as an interface for a number of sensors and controls throughout the Lease Area. O&M personnel would visit the site routinely for equipment inspections and to perform planned and unplanned maintenance activities (see Table 3.1-6 for general list of O&M activities and timeframes).

Table 3.1-6. OSP O&M schedule

O&M Task	Inspection Cycle
Routine inspections	As required based on final OSP design
Maintenance of switchgear and equipment	Annually
Transformer oil sample and targeted maintenance	Every 3 years
Extended maintenance routines	Every 5 and 10 years
Unplanned maintenance	As needed

Source: COP Volume 1, Table 3-11, SouthCoast Wind 2023.

3.1.2.3 Foundations

3.1.2.3.1 Description

Foundations refer to the structures that support both the WTGs and OSPs. Foundation concepts considered for WTGs and OSPs include monopile, piled jacket, and suction-bucket jacket. Suction-bucket jacket foundations would only be used for up to 85 positions in the southern portion of the Lease Area for Project 2 (Figure 3.1-5). See Table 3.1-7 and Table 3.1-8 for the maximum foundation parameters within the PDE.

Table 3.1-7. Maximum WTG foundation parameters

Foundation Type	Number of Foundations (Pile or Bucket)	Penetration Below Level Seabed	Foundation Diameter (Pile or Bucket)	Seabed Centerline Diameter	Footprint Diameter[1]
Monopiles	1	164.0 ft (50.0 m)	52.5 ft (16.0 m)	--	374.0 ft (114.0 m)
Piled Jacket	4	229.6 ft (70.0 m)	14.7 ft (4.5 m)	164.0 ft (50.0 m)	380.5 ft (116.0 m)
Suction-Bucket Jacket	4	65.6 ft (20.0 m)	65.6 ft (20.0 m)	180.4 ft (55.0 m)	521.6 ft (159.0 m)

Source: COP Volume 1, Table 3-2, SouthCoast Wind 2023.
[1] Diameter measures across combined area from foundation, scour protection, and mud mats
ft = foot; m = meter.

Table 3.1-8. Maximum OSP foundation parameters

OSP Option	Foundation Type	Number of Foundations	Penetration Below Level Seabed	Piles or Bucket Diameter at Mudline	Seabed Centerline Diameter or Dimension	Permanent Footprint Area[1]
Option A – Modular	Monopile	1	164.0 ft (50.0 m)	52.5 ft (16.0 m)	52.5 ft (16.0 m)	2.52 ac (1.02 ha)
	Piled Jacket	3 to 4 foundations and 1 to 2 piles/ foundation = 3 to 8 piles	229.6 ft (70.0 m)	14.7 ft (4.5 m)	164.0 ft (50.0 m)	2.61 ac (1.05 ha)
	Suction-Bucket Jacket	4 foundations and 1 bucket/foundation = 4 buckets	65.6 ft (20.0 m)	65.6 ft (20.0 m)	180.4 ft (55.0 m)	4.90 ac (1.98 ha)
Option B – Integrated	Piled Jacket	4 to 6 foundations and 1 to 3 pile/ foundation = 4 to 12 piles	277.2 ft (84.5 m)	11.7 ft (3.57 m)	213 x 105 ft (65 x 32 m)	7.54 ac (3.05 ha)
Option C – DC Converter	Piled Jacket	4 foundations and 3 to 4 piles/ foundations = up to 16 piles	262.4 ft (80.0 m)	12.8 ft (3.9 m)	279 x 197 ft (85 x 60 m)	9.79 ac (3.96 ha)

Source: modified from COP Volume 1, Table 3-3, SouthCoast Wind 2023 with additional information from SouthCoast Wind to support ESA consultation.
[1] Includes combined area from foundation, scour protection, and mud mats.
ac = acre; ft = foot; ha = hectare; m = meter; N/A = not applicable.

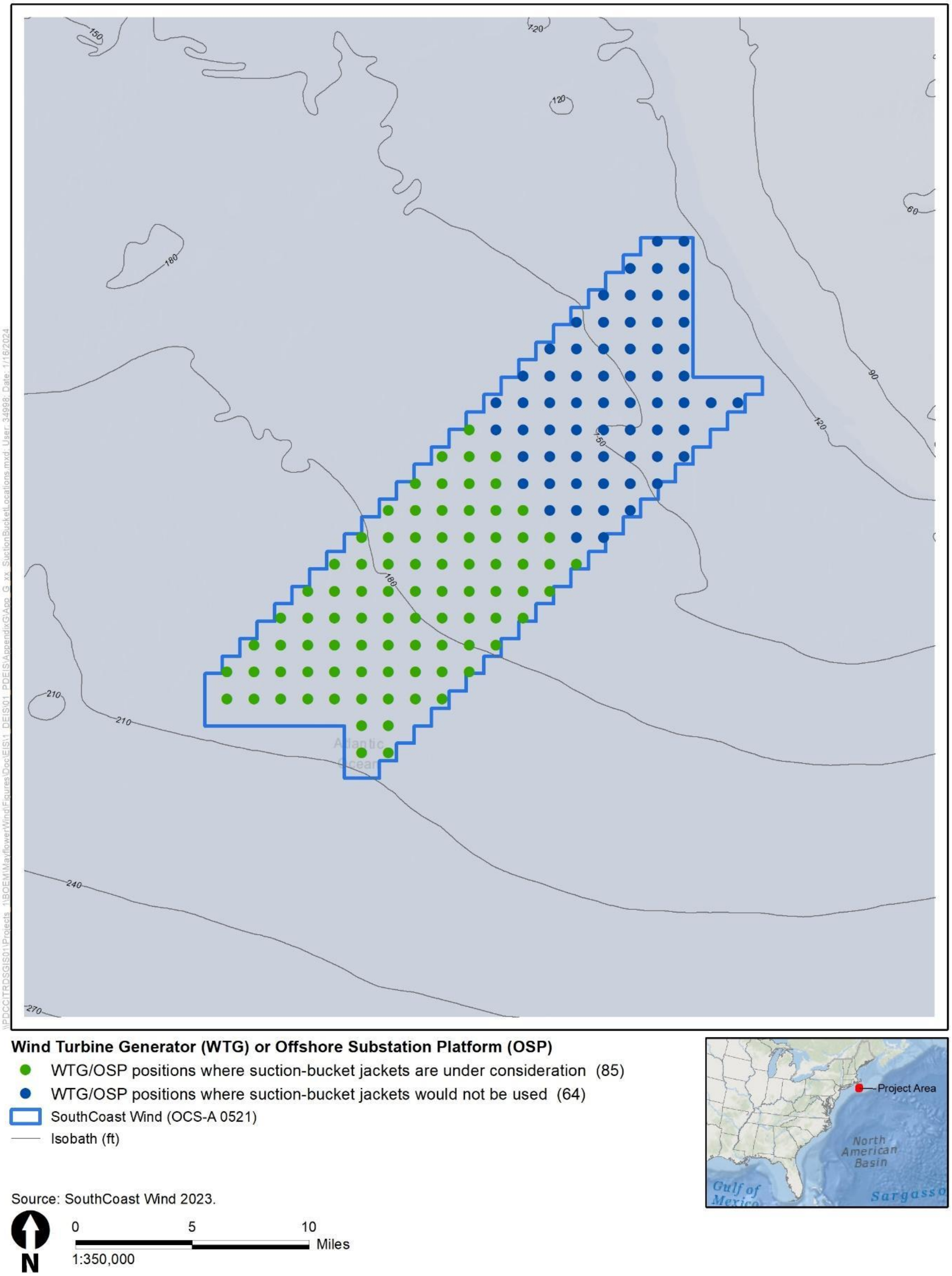


Figure 3.1-5. WTG/OSP positions where suction-bucket jacket foundations are under consideration

3.1.2.3.1.1 Monopile

Monopiles consist of a single vertical, hollow steel pile connected to a transition piece, which attaches the WTG tower/OSP topside to the monopile above the water line. Monopiles can be used for both supporting the WTGs and the Modular OSP, Option A. A diagram of a monopile with typical dimensions can be seen in Figure 3.1-6.

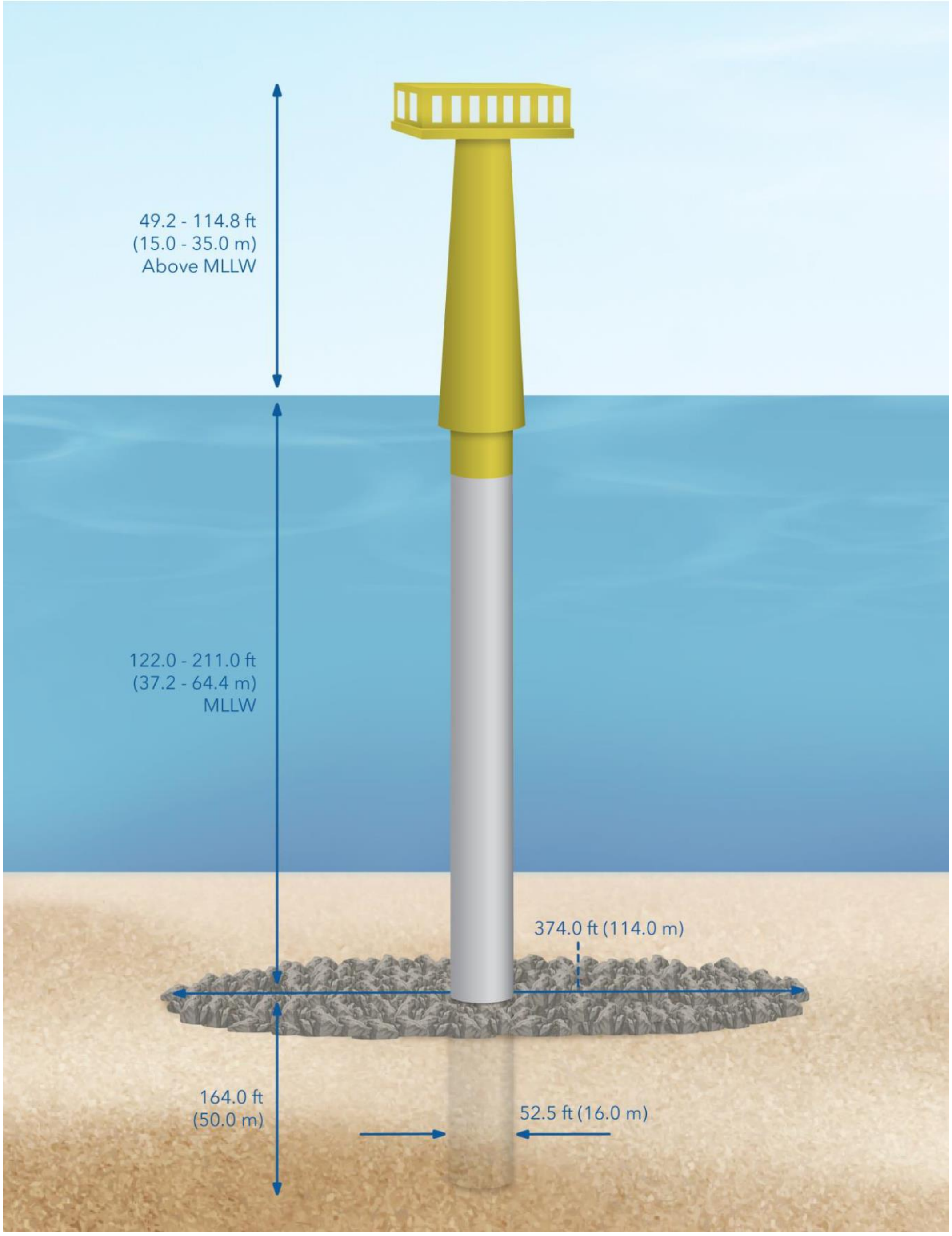


Figure 3.1-6. Indicative WTG monopile foundation diagram

3.1.2.3.1.2 Piled Jacket

Jacket structures are large lattice structures fabricated of steel tubes welded together. Jackets will consist of three- or four-legged structures to support WTGs and four- to nine-legged structures to support OSPs. If the jacket is piled, each leg will be anchored by one pile foundation for WTGs and up to three pile foundations per leg for OSPs. A diagram of a pile jacket with typical dimensions can be seen in Figure 3.1-7.

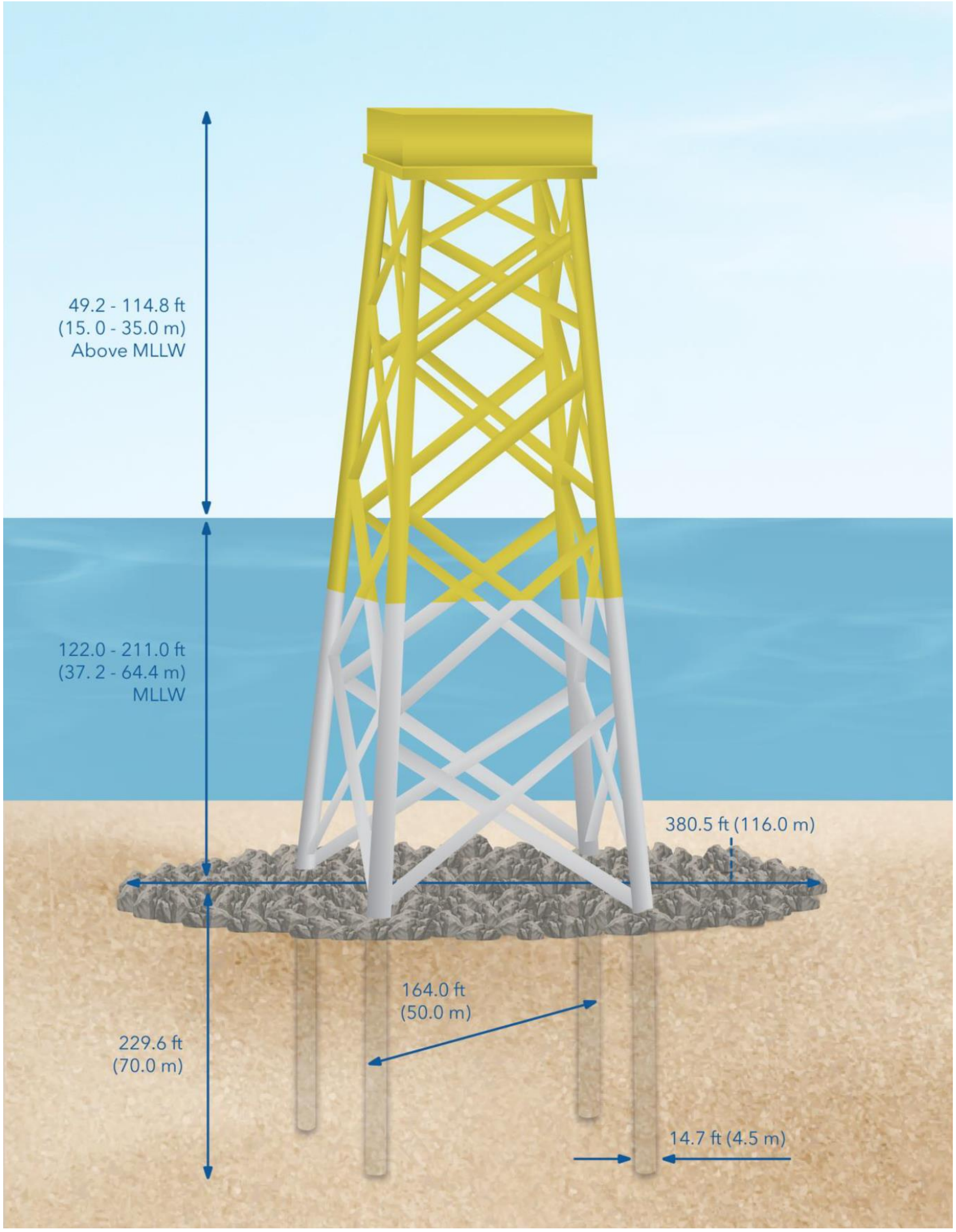


Figure 3.1-7. Indicative WTG piled jacket foundation diagram

3.1.2.3.1.3 Suction-Bucket Jacket

Suction-bucket jackets have a similar steel lattice design to the piled jacket but diverge at the connection to the sea floor. These foundations use suction-bucket foundations instead of piles to secure the structure to the seabed. A diagram of a suction-bucket jackets with typical dimensions can be seen in Figure 3.1-8.

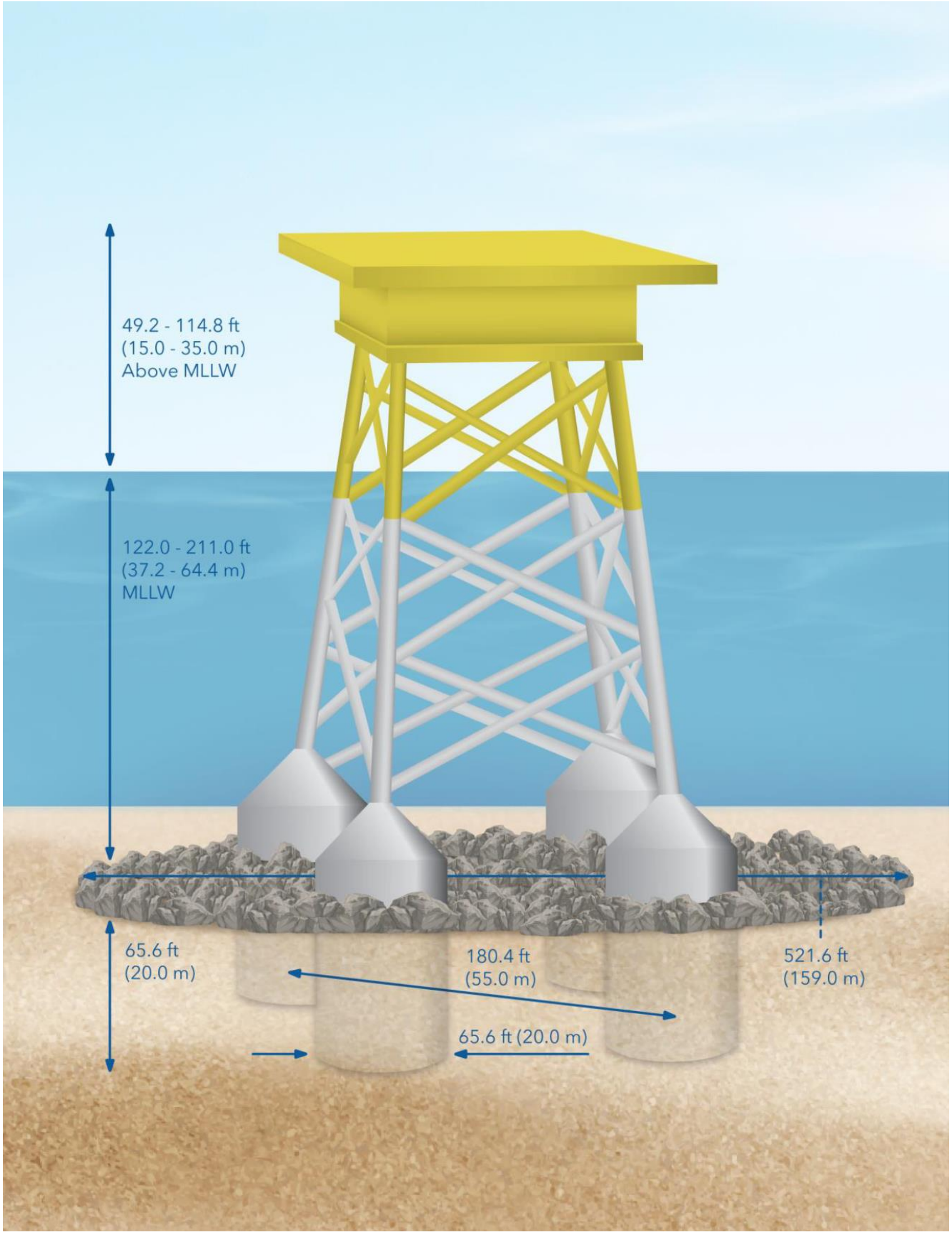


Figure 3.1-8. Indicative WTG suction-bucket foundation diagram

3.1.2.3.2 Foundation Installation

During construction, SouthCoast Wind would receive equipment and materials to be staged and loaded onto installation vessels at one or more existing port facilities (Section 3.1.1). Installation vessels would then transport equipment and materials to the Lease Area. Use of these vessels, and other construction vessels that would be used for installation of WTG and OSP foundations, is described in Section 3.1.2.6. At a maximum, the Project would have up to two vessels working simultaneously (e.g., two piled jacket vessels or one monopile vessel and one piled jacket vessel) to install foundations. This will only occur in the case when one vessel is installing an OSP foundation (piled jacket vessel) and the other is installing a WTG foundation (monopile vessel or piled jacket vessel). Seafloor preparation, in the form of surface or subsurface debris removal, boulder relocation, and in-situ UXO/Munitions and Explosives of Concern disposal, may be required prior to the installation of WTG and OSP foundations in certain areas depending on seabed condition and the foundation type. Seabed leveling and dredging would not be required for any foundation type. There is an absence of boulder fields and individual boulders found in the 2020 and 2021 High-Resolution Geophysical (HRG) mapping of the Lease Area (Appendix E, SouthCoast Wind 2023); however, a boulder relocation plan is currently in development for the ECCs and would apply to the interarray cables in the Lease Area should boulder removal and relocation become necessary. The estimated temporary and permanent disturbance areas associated with seabed preparation and foundation installation are provided in Table 3.1-9. Total seabed disturbance footprint from jack-up vessel use during WTG/OSP installation in the Lease Area would be 442 acres (179 hectares).

For monopiles and piled jacket foundations, pile-driving activity would be limited to between June 1 to October 15 within 20 kilometers of the 30-meter isobath on the west side of Nantucket Shoals and between May 15 to December 31 anywhere in the Lease Area based on time of year restrictions to reduce impacts on North Atlantic right whale (NARW) and other marine mammals, which are most present in the Project area from January to April (refer to Section 3.3). Pile driving may occur 24 hours per day to complete installation within as few years as possible during the multiple-year installation campaign expected for the entire Lease Area build-out. Installations of monopiles and piled jackets may occur on a schedule using both impact and vibratory hammering, which is described in detail in Section 5.2.1. Due to concerns around pile driving in the vicinity of the Nantucket Shoals area and the larger ensonified area associated with vibratory piling, no vibratory pile driving is planned for foundation installation for the construction of Project 1. Prior to conducting nighttime pile driving, SouthCoast Wind would be required to submit a Nighttime Pile Driving Plan (NPDP) to BOEM and NMFS for approval. The NPDP will describe the methods, technologies, monitoring zones, and mitigation requirements for any nighttime pile driving activities. Nighttime pile driving activities would be those occurring between 1.5 hours before civil sunset to one hour after civil sunrise. The Alternative Monitoring Plan (AMP) would describe details of the monitoring methods that will be used during low-visibility conditions and the efficacy of the alternative technologies that are demonstrated to allow monitoring of the entire pre-clearance and shutdown zones during daylight hours. BOEM does not anticipate an AMP would be required in lieu of any approved NPDP. In the absence of an approved NPDP, all pile driving would be initiated during daytime (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 prevent the completion of pile driving during daylight hours and was deemed necessary to continue piling during the night to protect asset integrity or safety. Monitoring and mitigation measures for pile-driving activities, including nighttime pile driving, are provided in Section 3.3.

3.1.2.3.2.1 Monopile Installation

WTG and OSP monopile foundations with a maximum diameter of 52-foot (16-meter) monopiles would be installed within the Lease Area using an impact pile driver with a maximum hammer energy of 6,600 (kilojoules [kJ]) or a vibratory hammer (or both). Monopiles would be installed to a maximum depth of

164 feet (50 meters). Under normal conditions, installation of a single monopile foundation is estimated to require approximately 4 hours of piling. It is anticipated that a maximum of two monopile foundations can be driven into the seabed per day assuming 24-hour pile-driving operation; however, installation of 1 pile per day is expected to be more common and the installation schedule used in the exposure modeling discussed in Section 5.2.2 reflects this (LGL 2024). The time required to install each pile would also include a 1-hour pre-start clearance period and then 4 hours to move to the next piling location.

3.1.2.3.2.2 Piled Jacket Installation

WTG piled jacket foundations, with four legs and one pin-pile per leg, with a maximum pile diameter of 14.7 feet (4.5 meters) would be installed using an impact pile driver with a maximum hammer energy of 3,500 kJ or a vibratory hammer (or both) to a maximum penetration depth of 229.6 feet (70 meters). Installation of a single pin-piled jacket substructure is estimated to require approximately 8 hours of pile driving (2 hours of pile driving per pin pile foundation, four piles per jacket substructure). It is anticipated that a single piled jacket substructure involving four pin-pile foundations can be driven into the seabed per day assuming 24-hour pile-driving operation. Piled jacket installation is multi-stage where the seabed is prepared and then a reusable template is placed on the seabed for accurate positioning of piles. Pin piles will be individually lowered into the template and driven to the target penetration depth using an impact hammer. Then the template is picked up and moved to the next location. In the subsequent stage of the installation process, a vessel installs the jacket to the piles. This could occur directly after the piling vessel completes operations, or a year later.

OSP piled jacket foundations would be similar to the WTG piled jacket foundations described above. However, OSP piled jackets would be installed using a post-piling installation sequence. Post-piling installation is a sequence where the seabed is prepared and the jacket is set on the seafloor, then the piles are driven through the jacket legs to the designed penetration depth (depending on which OSP design is used). The piles are connected to the jacket via grouted or swaged connections or a combination of the two. OSP piled jackets may have up to six legs, and each leg could be anchored by up to four pin piles. The number of jacket legs and pin piles would vary depending on the OSP design being supported as follows:

- Option A (modular) OSP design would be the smallest and include three to four legs with one to two pin piles per leg (three to eight total pin piles per pile jacket). Pin piles would have a diameter of up to 14.7 feet (4.5 meters) and would be installed using up to a 3,500-kJ hammer to a target penetration depth of 229.6 feet (70 meters) below the seabed.
- Option B (integrated) OSP design would include four to six legs with one to three piles per leg (4 to 12 total pin piles per jacket). The pin pile diameter would be up to 11.7 feet (3.57 meters), and they would be installed using up to a 3,500-kJ hammer to a target penetration depth of 277.2 feet (84.5 meters) below the seabed.
- Option C (HVDC converter) OSP design with a piled jacket substructure would include four legs with three to four pin piles per leg (up to 16 total pin piles per jacket) with a pile diameter of 12.8 feet (3.9 meters) installed using a 3,500-kJ hammer to a target penetration depth of 262.4 feet (80 meters) below the seabed.

For all three OSP piled jacket options (modular, integrated, and HVDC-converter), installation of a single pin pile is anticipated to take up to 2 hours of pile driving. A maximum of eight pin piles could be driven into the seabed per day during 24-hour pile driving operation.

3.1.2.3.2.3 Suction-Bucket Jacket Installation

During installation of suction-bucket jacket substructures for WTGs and OSPs, the jacket is lowered to the seabed, and the open bottom of the bucket and weight of the jacket embeds the bottom of the bucket in the seabed. To complete the installation and secure the foundation, water and air are pumped out of the bucket at an approximate rate of 300 to 500 cubic meters per hour creating negative pressure within the bucket of approximately five bar, which embeds the foundation buckets into the seabed. The jacket can also be leveled at this stage by varying the applied pressure. The pumps will then be released from the suction buckets once the jacket reaches its designed penetration depth of 65.6 feet (20 meters) (Figure 3.1-8). The connection of the required suction hoses is typically completed using a remotely operated vehicle (ROV). A typical duration for suction bucket jacket installation is 15 to 20 hours per foundation. Suction bucket jackets remain in the Project 2 foundations PDE, but currently are not preferred over monopiles and piled jackets. Pump parameters (such as flow rate) depend on the final design of the suction bucket foundation. However, the flow rate will be designed so that seabed disturbance is avoided. Each bucket would have a diameter of up to 65.6 feet (20 meters) and a maximum volume of up to ~8,894 cubic yards (6,800 cubic meters).

3.1.2.3.3 Scour Protection

Scour protection would be installed around WTG and OSP foundations to prevent scouring of the seabed around the foundations. The type and amount of scour protection utilized will vary based on a variety of factors, including foundation type and water flow and substrate type (hydrodynamic scour modeling). The scour protection types proposed are:

- Rock: the installation of crushed rock or boulders around a structure.
- Rock bags: pre-filled bags made of meshed steel or synthetic materials containing crushed rock to be placed around a structure.
- Concrete mattresses: the installation of pre-cast blocks of concrete around a structure.
- Sandbags: pre-filled bags containing sand.
- Artificial seaweeds/reefs/frond mats: mattresses including polypropylene or similar fronds that accumulate soft sediment.
- Self-deploying umbrella systems: used for suction-bucket jackets, the system entails pre-installed frond mats that deploy during installation of the suction buckets.

Synthetic material may be used for some scour protection options, including rock bags and fronded mattress, which would be tested for long-term durability. The material would be designed and tested to maintain integrity under ultraviolet (UV) exposure, though UV exposure becomes much less significant on the seabed.

Installation activities and order of events of scour protection would largely depend on the type and material used. In the case of rock scour protection, a rock placement vessel may be deployed. The thin layer of filter stones is typically placed before driving the piles, while the armor rock layer is typically installed afterward. Final scour protection strategy and installation will be refined during detailed design. Scour protection would follow the installation of these foundations. Frond mats or umbrella-based structures may be pre-attached to the substructure, so are therefore simultaneously installed.

Maximum seabed disturbance parameters, including scour protection, for 147 WTGs and 2 OSPs (includes OSPs with largest seabed footprint) are presented in Table 3.1-9.

Table 3.1-9. Temporary disturbance, permanent disturbance, and scour parameters for WTG and OSP foundations

Parameter – WTGs	Monopile	Piled Jacket	Suction Bucket Jacket*
Permanent Footprint Area per WTG (including scour protection)	2.5 ac (1.0 ha)	2.6 ac (1.1 ha)	4.9 ac (2.0 ha)
Total Permanent Footprint Area (147 WTG foundations, including scour protection)	370.4 ac (149.9 ha)	383.7 ac (154.4 ha)	578.3 ac* (234.0 ha)
Scour Protection Volume per WTG	36,256 cy (27,720 m^3)	37,635 cy (28,774 m^3)	75,583 cy (57,787 m^3)
Total Scour Protection Volume (147 WTGs)	5,329,632 cy (4,074,840 m^3)	5,532,345 cy (4,229,778 m^3)	8,757,925 cy* (6,695,914 m^3)
Additional Temporary Disturbance from Seafloor Preparation During Construction per WTG	0.5 ac (0.2 ha)	0.5 ac (0.2 ha)	0.6 ac (0.3 ha)
Total Additional Temporary Disturbance from Seafloor Preparation During Construction (147 WTGs)	73.5 ac (29.4 ha)	73.5 ac (29.4 ha)	82.0 ac* (33.2 ha)
Parameter – OSPs (maximum disturbance)		**Piled Jacket**	
Permanent Footprint Area per OSP (including scour protection)		9.8 ac (3.96 ha)	
Total Permanent Footprint Area (2 OSPs, including scour protection)		19.6 ac (7.4 ha)	
Scour Protection Volume per OSP		157,193 cy (120,183 m^3)	
Total Scour Protection Volume (2 OSPs)		314,386 cy (240,366 m^3)	
Additional Temporary Disturbance from Seafloor Preparation During Construction per OSP		0.5 ac (0.2 ha)	
Total Additional Temporary Disturbance from Seafloor Preparation During Construction (2 OSPs)		1.0 ac (0.4 ha)	

* Total values in the suction-bucket jacket column are calculated using the assumed maximum 85 suction-bucket jacket foundations are installed along with 62 piled jacket foundations (for up to 147 WTGs).
Source: adapted from COP Volume 1, Tables 3-6, 3-7, 3-36, and 3-37; SouthCoast Wind 2023.
Ac = acre; cy = cubic yard; ha = hectare; m^3 = cubic meter

3.1.2.3.4 Operation and Maintenance

Internal and external inspections of foundations will occur every 2 years to ensure structural integrity. ROVs or Autonomous Underwater Vehicles (AUVs) will be deployed for general underwater visual inspections that will include detection of corrosion, damage to the substructure, cracks at welds, excessive marine growth, and seabed scour. Divers may be used in a limited capacity for inspection or repair activities.

3.1.2.4 Cable Types

3.1.2.4.1 Interarray Cables

3.1.2.4.1.1 Description

The interarray cables would connect the WTGs into strings and then connect these strings to the OSPs. The proposed interarray cable is an alternating current (AC), three-core (three separate conductors/cores), armored submarine cable that would be a maximum length of 497.1 miles (800 kilometers) in length with a voltage between 60 and 72.5 kilovolts (kV) (Table 3.1-2). The final layout of the interarray cables would be determined at a later date based on site characterization data, cable capacity, and installation and operating conditions.

3.1.2.4.1.2 Interarray Cable Installation

Seabed preparation activities would be conducted prior to the installation to prepare for cable installation and ensure consistent burial is achieved. Boulders in the cable route that cannot be easily avoided by micro-routing could be removed with a grab lift or plow as necessary. Dredging and sand wave clearance is not proposed in the Lease Area in preparation for inter-interarray cable installation (dredging and sand wave clearance is proposed in the Falmouth ECC as noted in Section 3.1.2.4.2.2). It is anticipated that a pre-lay grapnel run would be completed along the entire length of each interarray cable route within the Lease Area shortly before cable installation. A pre-lay grapnel run would be conducted to clear the cable route of buried hazards along the installation route to remove obstacles that could impact cable installation, such as abandoned mooring lines, wires, or derelict fishing gear. SouthCoast Wind will coordinate with relevant federal and state agencies in addition to SouthCoast Wind’s other outreach efforts (i.e., direct outreach, outreach via Fisheries Representatives) to notify commercial and recreational fishermen prior to initiation of the pre-lay grapnel run. Table 3.1-10 shows acres of seabed disturbance from seabed preparation activity.

Interarray installation methods would be similar to offshore export cable installation and include a combination of jetting ROV, pre-cut plow, mechanical plow, or mechanical cutting ROV system. These installation methods are described in Section 3.1.2.4.2.2. A dynamic positioning (DP) vessel would be used for cable installation and there would be no anchoring in the Lease Area (refer to Section 3.1.2.6 for vessel use description). Cables would be buried to a target depth of 6 feet (1.8 meters) where possible. In locations where target burial depth cannot be achieved (minimum anticipated burial depth is 3.1 feet [1 meter]) and at existing cable crossings, cable protection would be used. SouthCoast Wind estimates 10 percent of the interarray cable layout would require cable protection (approximately 49.7 miles [80 kilometers]). Locations requiring cable protection, the type of protection selected, and the amount of cable protection would be determined based on a variety of factors, including water flow and substrate type. The proposed cable protection types are as follows:

- Rock berm: the creation of a sloped rock berm over the cable.
- Concrete mattresses: concrete blocks, or mats, connected via rope or cable.
- Rock placement: the installation of crushed boulders over a cable.
- Fronded mattress: mat made of polypropylene or similar fronds (as described previously for scour protection, fronded mattress would be designed to ensure that integrity from UV exposure).
- Half shells: typically used to protect cable ends at pull-in areas and where trenching is not possible.

Seabed disturbance from the interarray cables is summarized in Table 3.1-10.

Table 3.1-10. Interarray cable—estimated seabed disturbance areas

Interarray Cable Activity	Area in Acres (Hectares)
Seabed Preparation	99 (40)
Cable Installation[1]	1,186 (480)
Cable Protection[2]	122 (50)
Total Area Disturbed	**1,408 (570)**

Source: COP Volume 1, Table 3-30, SouthCoast Wind 2023.
[1] Width of surface impact estimated to be 19.7 feet (6 meters) around each cable.
[2] A maximum of 19.7-foot-wide (6-meter-wide) form of cable protection would be installed along 10 percent of the interarray cable layout.

3.1.2.4.1.3 Operation and Maintenance

The interarray cables are buried and not expected to require regular maintenance, except for manufacturer-recommended cable testing. Periodic visual inspections of the interarray cables would be planned based on survey data and manufacturer recommendations based on the as-built drawings. Episodic repairs of cable faults, failures, and exposed cables would be conducted as necessary. These repairs would require the use of various cable installation equipment, as described for construction activities.

3.1.2.4.2 Offshore Export Cables

3.1.2.4.2.1 Description

The Proposed Action includes one preferred ECC to Brayton Point and one variant ECC to Falmouth. The Brayton Point ECC will be used for both Project 1 and Project 2 while the Falmouth variant ECC will only be used for Project 2 in the event that technical, logistical, grid interconnection, or other unforeseen challenges arise during the design and engineering phase that prevent Project 2 from making interconnection at Brayton Point.

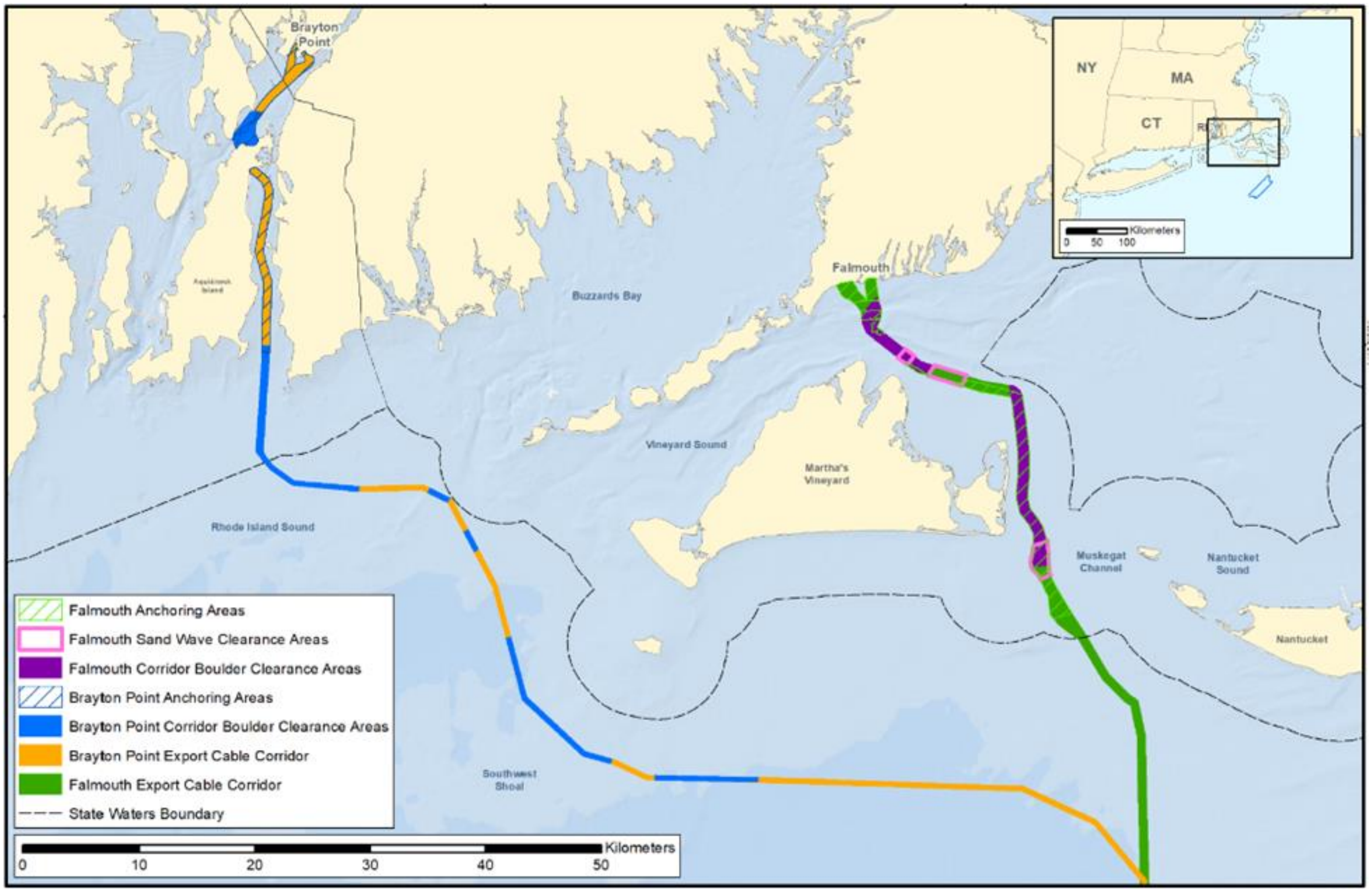
Within the Brayton Point ECC, a maximum of six offshore export cables, including four HVDC power cables and two dedicated communications cables, would connect the OSPs to the landfall site at Brayton Point. The cables would be installed in two cable bundles, consisting of two power cables and one communication cable. The length of all cables within the 124-mile (200-kilometer) corridor would be a maximum of 744 miles (1,200 kilometers). Within the Brayton Point ECC, no sand wave clearance is expected, so dredging will only occur at HDD exit pit locations (refer to Section 3.1.2.4.3). Potential dredge volumes could be up to 22,404 cubic yards (17,124 cubic meters).

Within the Falmouth ECC, a maximum of five offshore export cables, including four power cables and one dedicated communications cable, would connect the OSPs to the landfall site in Falmouth. Length of all cables within the 87-mile (140-kilometer) corridor would be a maximum of 435 miles (700 kilometers). Seabed preparation is expected within 5 percent of the Falmouth ECC for sand wave clearance via trailing suction hopper dredger or similar equipment. Suction hopper dredgers are typically self-propelled sea-going vessels equipped with propulsion machinery, sediment containers (i.e., hoppers), dredge pumps, and other specialized equipment required to excavate sediment from the bottom of the seafloor in thin layers usually 2 to 12 inches (5 to 30 centimeters) depending on the density and cohesiveness of the dredge material (Taylor 1990). The dredge works in a “back and forth” motion over the dredge area similar to a vacuum (NMFS and GARFO 2014; NMFS and GARFO 2019). Dredging may also occur at offshore HDD exit pit locations (refer to Section 3.1.2.4.3). The total volume of dredged material, including sand wave clearance and dredging at HDD exit pits, is estimated to be 646,077 cubic yards (493,962 cubic meters) for the Falmouth ECC.

SouthCoast Wind intends to maintain a maximum corridor width of 2,300 feet (700 meters) for the Brayton Point ECC and 3,280 feet (1,000 meters) for the Falmouth ECC to allow for maneuverability during installation and maintenance. The ECCs may be locally narrower or wider to accommodate sensitive locations and to provide sufficient area at landfall locations, at crossing locations, or for anchoring.

3.1.2.4.2.2 Offshore Export Cables Installation

Seabed preparation activities would be conducted prior to the installation to prepare for cable installation and ensure consistent burial is achieved. Seabed preparation activities may include boulder removal, grapnel runs, localized dredging, and seabed leveling (Figure 3.1-9). Boulders in the cable route that cannot be easily avoided by micro-routing could be removed with a grab lift or plow as necessary. Boulders will be relocated to areas of similar seabed conditions within the respective ECCs from which they were removed, and the coordinates and approximate sizes of the boulders will be recorded prior to and following relocation. If deemed necessary, a pre-lay grapnel run would be conducted to clear the cable route of buried hazards along the installation route to remove obstacles that could impact cable installation such as abandoned mooring lines, wires, or fishing equipment. Localized dredging using a hopper dredge or water injection dredge may be required in areas where sand waves are present, approximately five percent of the Falmouth ECC, primarily in Muskeget Channel in water depths less than 65 feet (20 meters). Hopper dredges are discussed previously. Dredged material would be disposed of within the ECC on similar substrate (i.e., other existing sand waves). Mounted on a barge, a water injection dredge jets water into the sediments at low pressure (10-12 pounds per square inch) and relatively high-volume flow rates to fluidize, displace, and mobilize sediments. The displaced sediments will be transported by gravity and natural water current. Table 3.1-12 identifies the areal extent of seabed preparation disturbance, including dredging, for both ECCs.



Source: COP Appendix M.3, Figure 2-28; SouthCoast Wind 2023

Figure 3.1-9. Anchoring areas, sand wave clearance areas, and boulder clearance areas

Once any necessary seabed preparations are completed, SouthCoast Wind would install the offshore export cables that would link OSPs to a sea-to-shore transition at their respective landfalls (refer to Section 3.1.2.4.3). SouthCoast Wind is proposing several preparation and installation methods. Cable burial would utilize one or a combination of the following methods:

- Vertical Injector: A vertical injector is a deep burial jetting tool used for cable installation and burial. The vertical injector uses water propelled from jet nozzles to fluidize the seabed material to allow for lowering of the cable. This tool is towed along the back of a vessel and acts as a trowel creating a space for the cable to be installed and subsequently buried.
- Jetting Sled: A jetting sled, possibly used along the export cable route, is towed from a vessel and can be launched either during post-lay trench mode or fitted with the cable to simultaneously create a trench through soft seabed material and lay the cable. The trench is created by water jetting through unconsolidated, softer seabed material. As such, jetting is optimal in unconsolidated soils and sands with low shear strengths. The trenching systems suffices for any curves that an offshore export cable may be laid in.
- Jetting ROV: This jet trencher is an ROV based system that can be launched from cable installation vessels or from a dedicated support vessel. This method is typically used in non-consolidated soils.
- Pre-Cut Plow: This method is deployed when surface and sub-surface boulders are present. A basic mechanical plow will pre-cut a V-shaped trench ahead of cable installation. This allows for the boulders and soils to be lifted to the edges of the trenches for backfill purposes later. Once the cable is laid into the trench, the plow is reconfigured into backfill mode where the boulders and soils that were previously relocated are then re-deposited.
- Mechanical Plow: A mechanical plow is towed from the back of a vessel and simultaneously cuts a narrow trench in the seafloor, while also simultaneously laying and burying cable. Plowing capability can increase from firm unconsolidated soils/sands to more consolidated soils and clays with medium shear strengths.
- Mechanical Cutting ROV System: A mechanical cutting ROV cable burial system is a self-propelled system most suitable for soil with increased strength. This system can be utilized at any water depth. The mechanical cutting ROV system utilizes a cutting wheel or chain to break up and excavate any material. It is used only in hard, consolidated soils; a rotating chain or cutting wheel with dedicated teeth will excavate the soil from beneath.

The final cable burial method(s) would be selected based on seabed conditions, the required burial depths, and pre-installation cable burial surveys and studies. More than one installation and burial method may be selected per route and has the potential to be used pre-installation, during installation, and/or post-installation. Target cable burial can be directly verified during installation of jetting type tools that are suitable for simultaneous laying and burial of the cables. These tools may be configured with a "depressor" or similar mechanical device that directly verifies the depth of the cable as it is being buried. Additionally, cable burial depth can be assessed post-installation using magnetic or acoustic remote-sensing techniques. The amount of seabed disturbance during installation activities is shown in Table 3.1-12.

Target horizontal separation between each proposed cable and cable bundle is a maximum of 328 feet (100 meters) for both ECCs. Final cable spacing will depend on bathymetry and other detailed seabed characteristics and may be wider or narrower.

A combination of moored (anchored) vessels and DP vessels would be used for the offshore export cable installation (refer to Section 3.1.2.6 for vessel use description). Moored vessels will typically be cable-lay barges, which employ a 6- or 8-point mooring pattern for station keeping, with temporary anchors deployed within the ECC and relocated along the relevant portion of the offshore export cable route. The split between vessels will be determined based on the water depth profile along the route and the route length compared to cable-carrying capacity. The DP vessels would be used for water depths greater than 49.2 feet (15.0 meters) while moored vessels would be used in nearshore areas and areas with shallow water less than 49.2 feet (15.0 meters). See Figure 3.1-10 and Figure 3.1-11 for potential anchoring areas along the Falmouth and Brayton Point ECCs, which would occur along a maximum of 30 percent (26 miles [41 kilometers]) of the Falmouth ECC and 15 percent (19 miles [30 kilometers]) of the Brayton Point ECC. SouthCoast Wind anticipates that the installation of fixed mooring(s) may be necessary in some locations in the Project area and will be determined at a later time. The location(s), mooring type, and number of moorings will be finalized and provided to BOEM pending final selection of suppliers. Anchoring disturbance is included in the cable installation disturbance acreage in Table 3.1-12.

Project cables would be buried to a target depth of 6 feet (1.8 meters) where possible. In locations where target burial depth cannot be achieved (minimum anticipated burial depth is 3.1 feet [1 meter]) and at existing cable crossings, cable protection would be used. A maximum of 10 percent of the Falmouth ECC (8.7 miles [14.0 kilometers]) and 15 percent of the Brayton Point ECC (18.6 miles [29.9 kilometers]) would require cable protection (refer to Table 3.1-12 for total area of cable protection). Locations requiring cable protection, the type of protection selected, and the amount of cable protection would be determined based on a variety of factors, including water flow and substrate type. The proposed cable protection types are as follows:

- Rock berm: the creation of a sloped rock berm over the cable.
- Concrete mattresses: concrete blocks, or mats, connected via rope or cable.
- Rock placement: the installation of crushed boulders over a cable.
- Fronded mattress: mat made of polypropylene or similar fronds (as described previously for scour protection, fronded mattress would be designed to ensure integrity from UV exposure).
- Half shells: typically used to protect cable ends at pull-in areas and where trenching is not possible.

At locations where the offshore export cables cross existing cables and pipelines, SouthCoast Wind would employ crossing designs consistent with typical industry practices, which typically employ use of concrete mattresses. Information on the locations and number of cable crossings by ECC are provided on Figure 3.1-12 and in Table 3.1-11. Cable crossing design will be determined by the cable crossing’s proximity to shore and the third-party crossing agreement requirements.

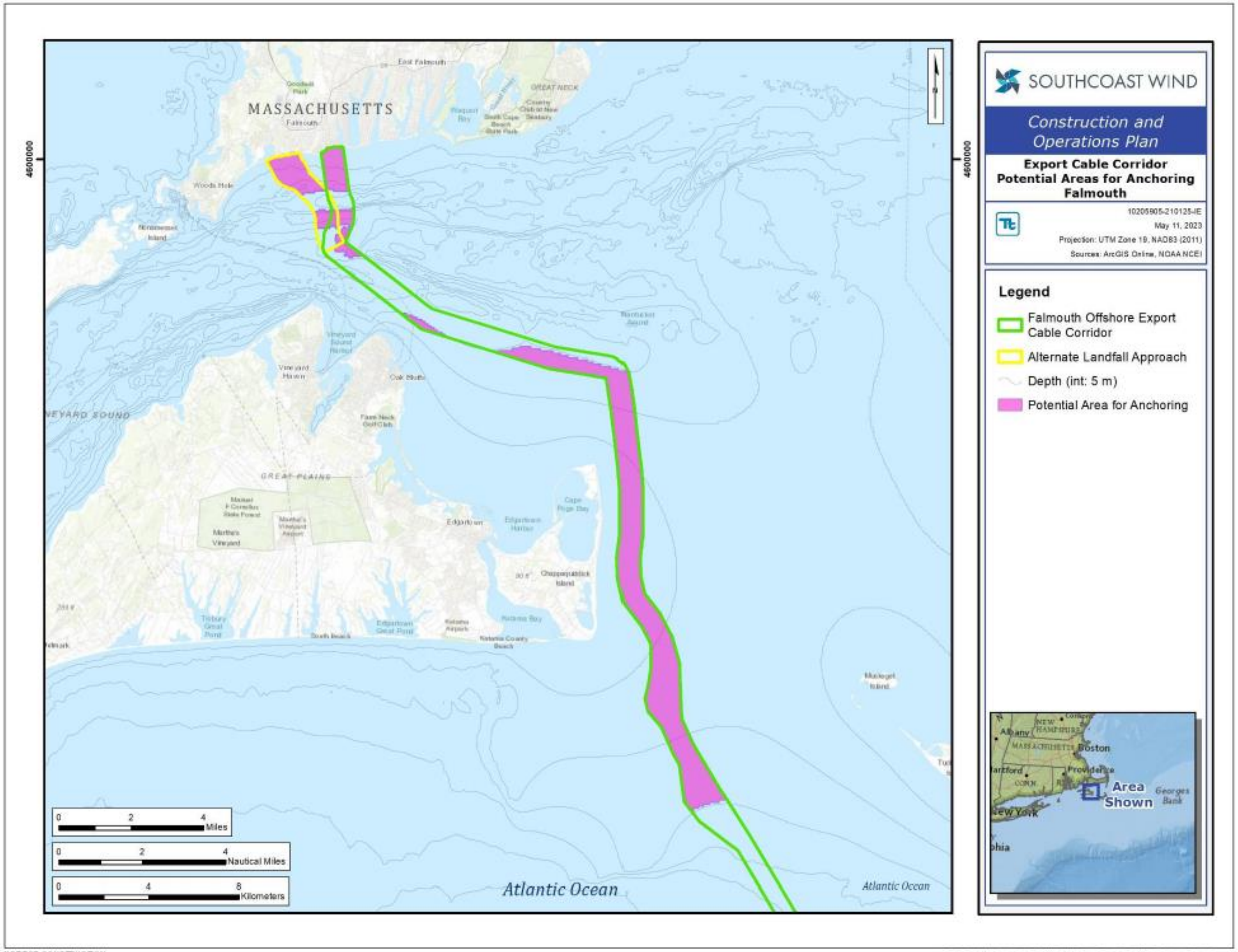


Figure 3.1-10. Potential areas for anchoring inside Falmouth export cable corridor

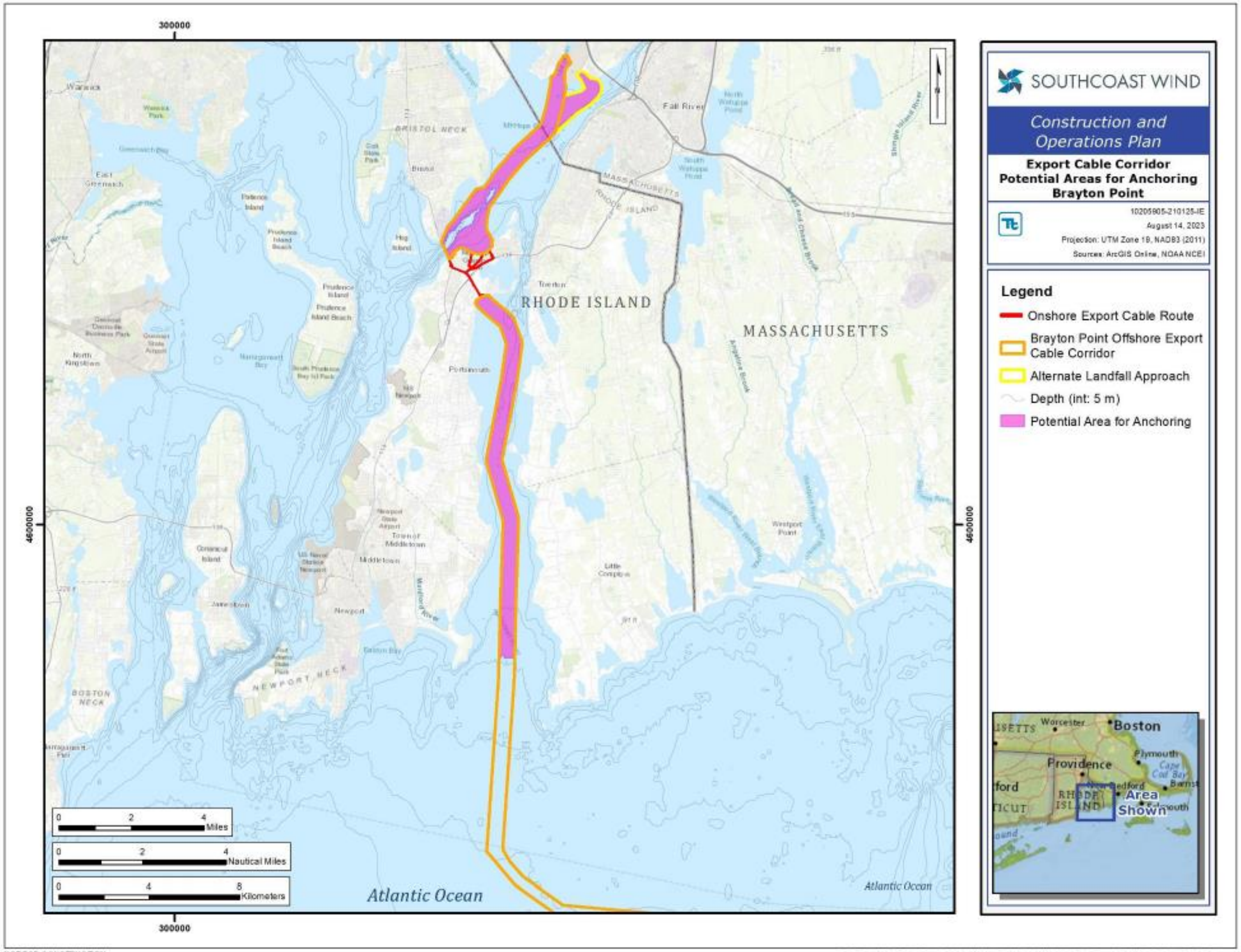


Figure 3.1-11. Potential areas for anchoring inside Brayton Point export cable corridor

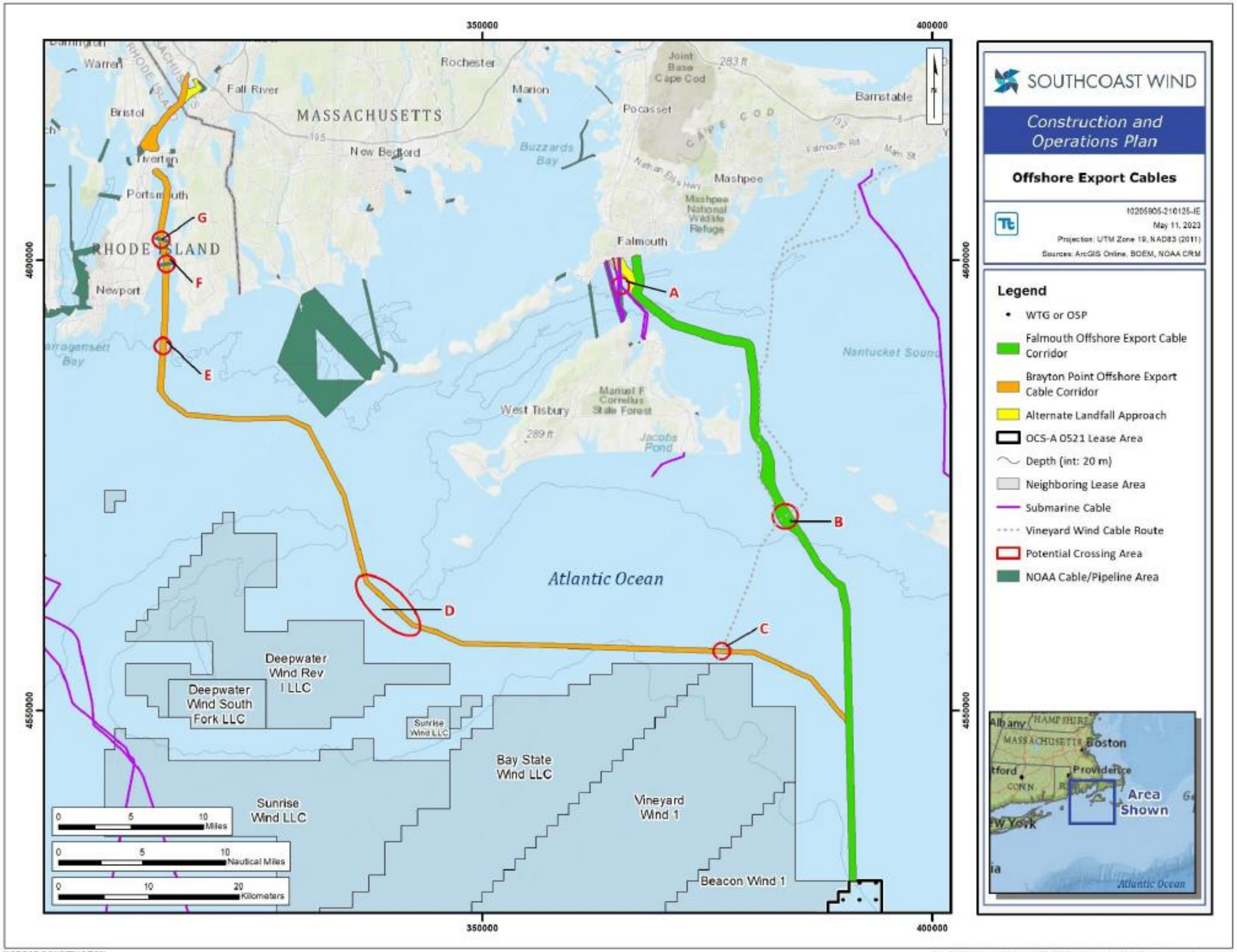


Figure 3.1-12. Potential cable and pipeline crossings

Table 3.1-11. Proposed cable/pipeline crossing

Cable Crossing Area (see Figure 3.1-12)	Number of Cables/Pipelines to be Crossed	Location	Offshore Export Cable Corridor
Potential Crossing Area A	2 cables	Between Martha's Vineyard and Falmouth (cables make landfall at Shore Street in Falmouth)	Falmouth ECC
Potential Crossing Area B	7 cables	South of Muskeget Channel	Falmouth ECC
Potential Crossing Area C	7 cables	South of Muskeget Channel	Brayton Point ECC
Potential Crossing Area D	4 cables	South of Nomans Land	Brayton Point ECC
Potential Crossing Area E	2 cables	South of Sakonnet River	Brayton Point ECC
Potential Crossing Area F	1 pipeline	Sakonnet River (charted Pipeline Area)	Brayton Point ECC
Potential Crossing Area G	Sakonnet River (charted Pipeline Area)	Sakonnet River (charted Pipeline Area)	Brayton Point ECC

Source: COP Volume 1, Table 3-15; SouthCoast Wind 2023.

Table 3.1-12. Offshore export cables—estimated seabed disturbance areas

Offshore Export Cable Activity	Area in Acres (Hectares)
Falmouth Export Cable	
Seabed Preparation (per cable)[1]	138 (56)
Cable Installation (per cable)[2]	186 (75)
Cable Protection (per cable)[3]	27 (11)
Total Seabed Disturbance Area (per cable)	351 (142)
Total Seabed Disturbance Area (5 cables)	1,753 (709)
Potential volume of dredged material (m^3)	493,962
Brayton Point Export Cable	
Seabed Preparation (per cable bundle)	65 (26)
Cable Installation (per cable bundle)[1]	242 (98)
Cable Protection (per cable bundle)[2]	56 (23)
Total Seabed Disturbance Area (per cable bundle)	363 (147)
Total Seabed Disturbance Area (2 cable bundles)	727 (294)
Potential volume of dredged material (m^3)	17,124

Source: COP Volume 1, Table 3-29; SouthCoast Wind 2023.
[1] Seabed preparation includes sand wave clearance and/or boulder field clearance
[2] Values also include anchor impacts. Width of surface impact estimated to be 19.7 feet (6 meters) around each cable.
[3] A maximum of 19.7-foot-wide (6-meter-wide) form of cable protection would be installed along 10 percent of the Falmouth ECC and 15 percent of the Brayton Point ECC.

3.1.2.4.2.3 Operations and Maintenance

The offshore export cables would be buried and not expected to require regular maintenance, except for manufacturer-recommended cable testing. Inspections and preventive maintenance would occur on a frequency advised by the manufacturer's recommendations. Burial inspection visuals would occur periodically to be determined after final design. Episodic repairs of cable faults, failures, and exposed cables would be conducted as necessary. These repairs would require the use of various cable installation equipment, as described for construction activities.

3.1.2.4.3 Sea-to-Shore Transition

3.1.2.4.3.1 Description

For the Falmouth ECC, SouthCoast Wind is considering three potential sea-to-shore transition locations in Falmouth, Massachusetts. For the Brayton Point ECC, SouthCoast Wind is considering two potential locations at Brayton Point in Somerset, Massachusetts, and four potential locations at the intermediate landfall on Aquidneck Island in Portsmouth, Rhode Island. The landfall locations in Falmouth, Massachusetts, include Worcester Avenue, Central Park, and Shore Street, as depicted in Figure 3.1-13. The landfall locations at Brayton point in Somerset, Massachusetts, include the Western landfall location from the Lee River and the Eastern landfall location from the Taunton River, as depicted in Figure 3.1-14. Additionally, the Brayton Point offshore export cables would make intermediate landfall on Aquidneck Island in Portsmouth, Rhode Island, in order to avoid a narrow and highly constrained area of the Sakonnet River at the old Stone Bridge and Sakonnet River Bridge, as depicted on Figure 3.1-15. This choice would require landfalls at two locations, one entering and one exiting Aquidneck Island. One landfall location is under consideration for entering Aquidneck Island, and four locations among three route options are under consideration for exiting Aquidneck Island.

3.1.2.4.3.1.1 *Falmouth ECC*

- **Falmouth Landfall Option A: Worcester Avenue (preferred).** The preferred landfall is the easternmost potential landfall site located at Worcester Avenue. This location is protected by a short seawall, a broad beach, and Surf Drive. This landfall site would be located on a previously disturbed, off-road grassy median strip (also known as Worcester Park) that runs between the two lanes of Worcester Avenue.
- **Falmouth Landfall Option B: Central Park.** This potential landfall site is approximately 700 feet (213 meters) west of the Worcester Avenue landfall location, situated at Central Park on Falmouth Heights Beach north of Grand Avenue. This landfall site would occur at a public recreational park with a baseball diamond and basketball court. The park is flanked on the southern side by paved parking spaces, which could be used for construction staging operations.
- **Falmouth Landfall Option C: Shore Street.** The potential landfall site at Shore Street is west of the Central Park and Worcester Avenue landfall sites. It is located on Surf Drive Beach at the intersection of Surf Drive and Shore Street. The Shore Street location has a large, over 2-acre (0.8-hectare) public parking lot that would be used to site the cable transition joint bays and accommodate vehicles and equipment during installation operations. The Shore Street landfall location involves the crossing of two existing submarine cables that also make landfall at Shore Street. The existing arrangement would allow SouthCoast Wind to use horizontal directional drilling (HDD) underneath the existing cables in the approach to the landfall location.

3.1.2.4.3.1.2 Brayton Point ECC

- **Brayton Point Landfall Option A: Western (preferred).** The preferred site for the Brayton Point landfall is located in the western portion of the former Brayton Point Power Station adjacent to where two cooling towers were previously located. This landfall occurs on the previously disturbed Brayton Point property where there is an open paved area for construction staging operations.
- **Brayton Point Landfall Option B: Eastern.** The Eastern alternate location for the Brayton Point landfall is located in the eastern portion of the former Brayton Point Power Station southeast of Brayton Point Road. This landfall occurs on the previously disturbed Brayton Point property that would hold construction staging operations.
- **Intermediate Landfalls on Aquidneck Island (Intermediate Landfall).** The Brayton Point ECC would make intermediate landfall on Aquidneck Island in Portsmouth, Rhode Island, for an underground onshore export cable route section. For the entry HDD to Aquidneck Island, one location is being considered at the intersection of Boyds Lane and Park Avenue. For the exit HDD into Mount Hope Bay, four locations are under consideration: one location northeast of the Mount Hope Bridge, one location along an existing overhead utility line corridor, one location along Anthony Road, and one location on the northeastern side of the Montaup Country Club golf course.

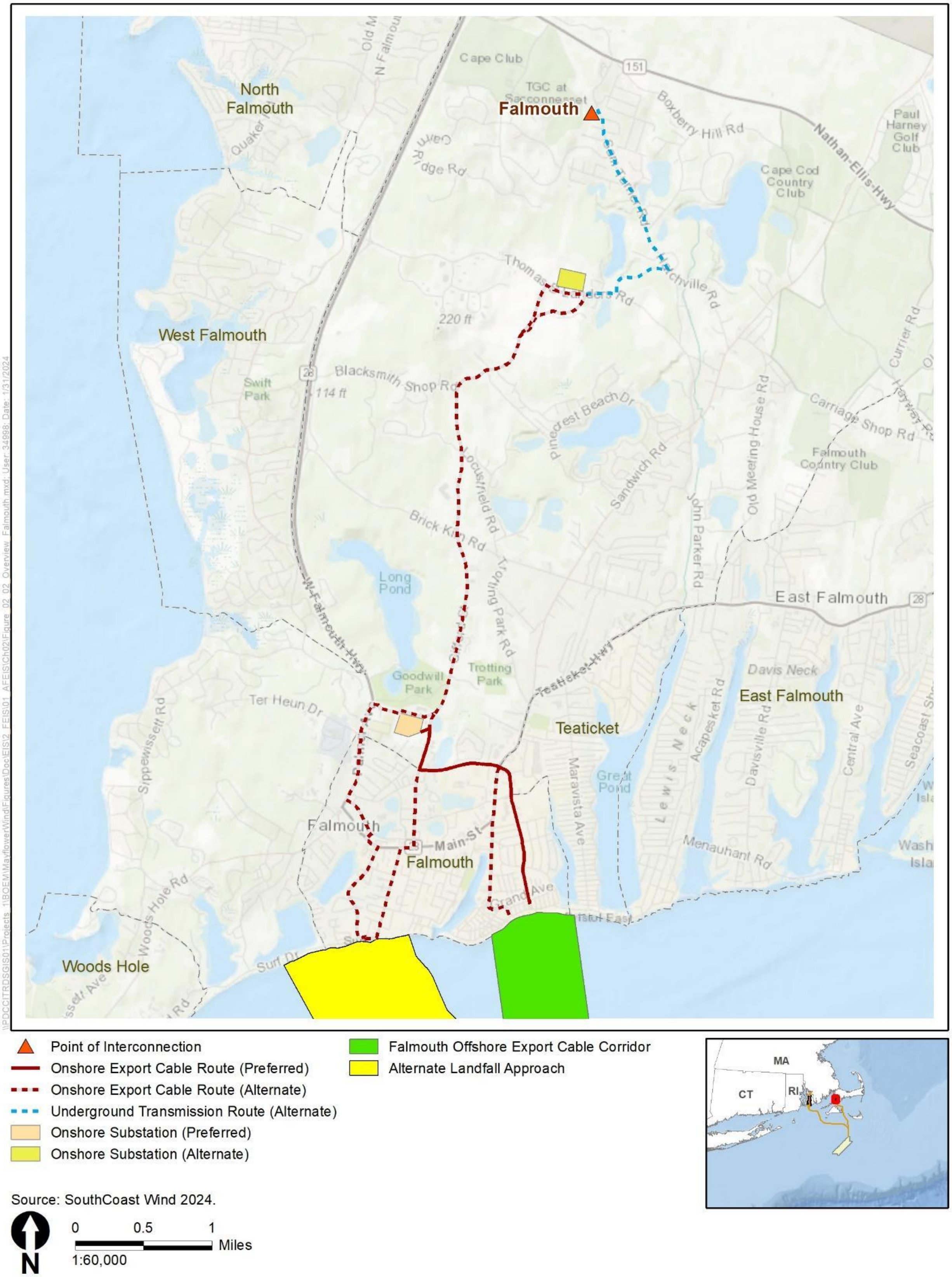


Figure 3.1-13. Falmouth ECC and landfall options

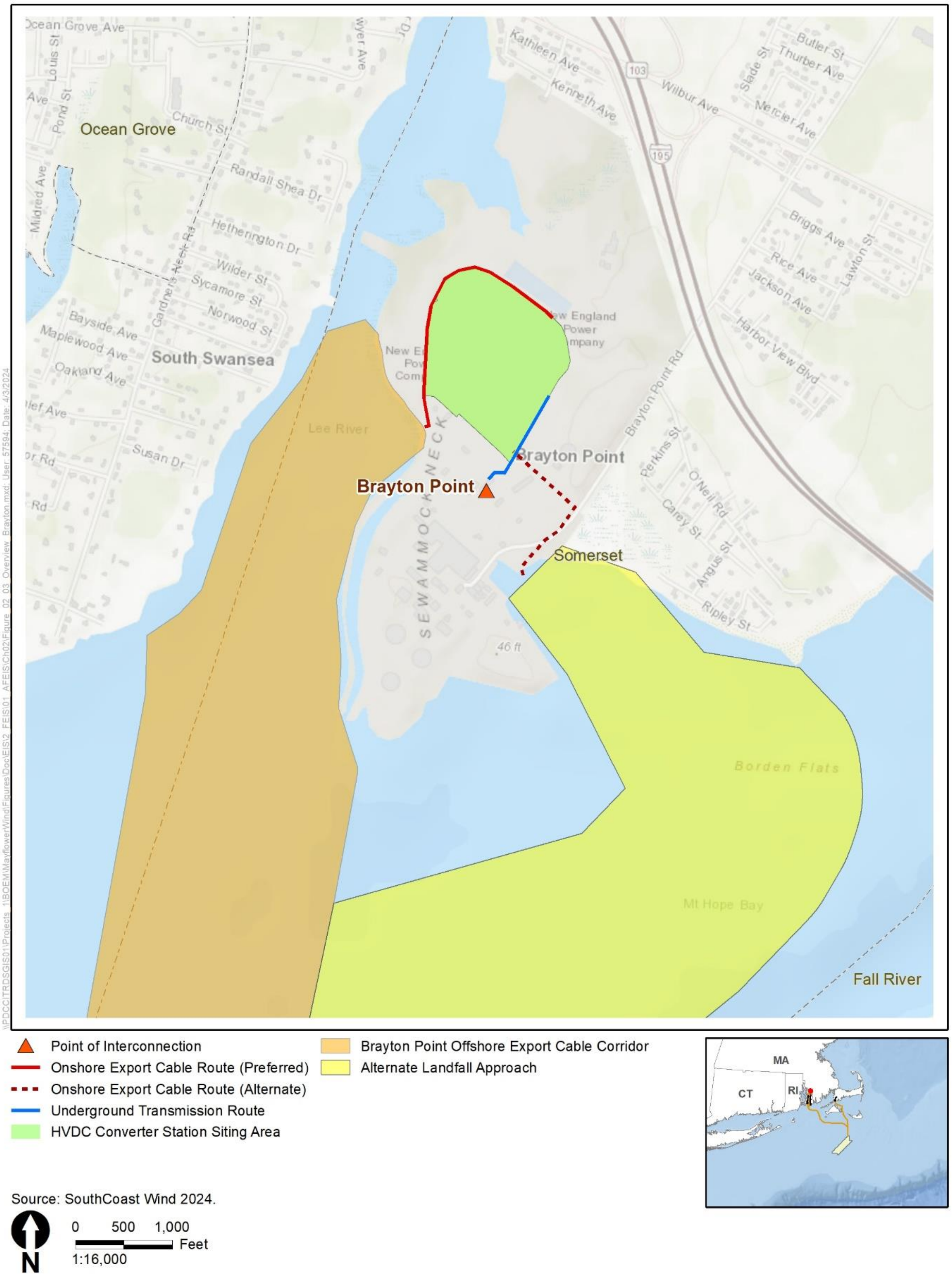


Figure 3.1-14. Brayton Point ECC and landfall options

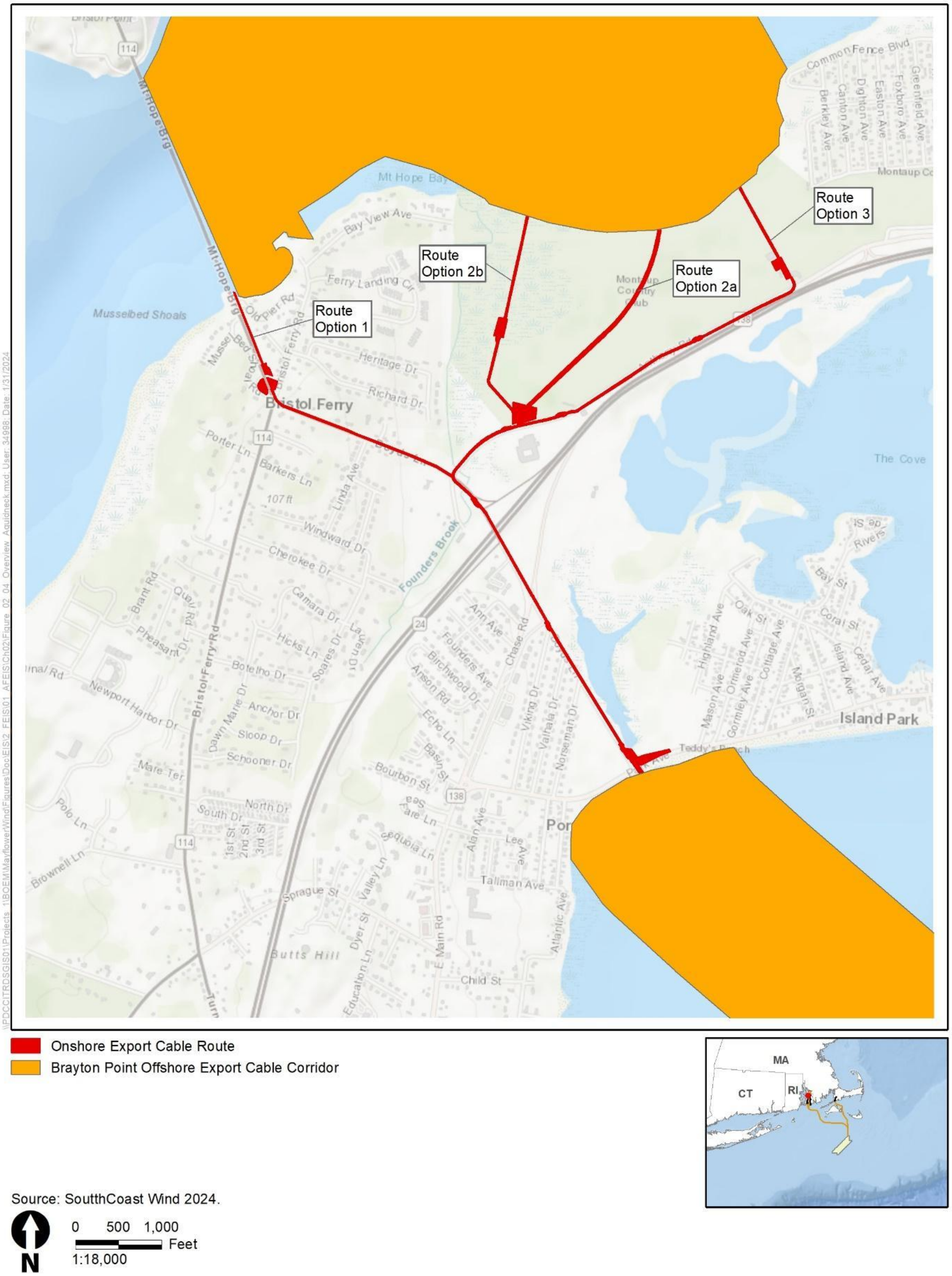


Figure 3.1-15. Brayton Point ECC and intermediate landfall options on Aquidneck Island

3.1.2.4.3.2 Sea-to-Shore Transition Installation

Installation of the landfall facilities would include the use of onshore excavation and construction equipment, HDD equipment, and offshore cable handling vessels and equipment. Drilling activities would occur on land with the borehole extending under the seabed to an exit point offshore, outside of the intertidal zone. To support this installation, both onshore and offshore work areas are required. Once the onshore work area is set up, the HDD activities would commence using a rig that drills a borehole underneath the surface.

HDD seaward exit points would be within 3,500 feet (1,069 meters) of the shoreline for the Falmouth ECC landfall, and within 1,000 feet (305 meters) of the shoreline for the Brayton Point landfalls. At the seaward exit point, construction activities may include either a temporary gravity-based structure (i.e., gravity cell or gravity-based cofferdam) and/or a dredged exit pit. Installation of both the temporary gravity-based structure and/or a dredged exit pit would not require pile driving or hammering. Additionally, a conductor pipe made of high-density polyethylene or similar material may be installed at the exit point to support the drill activity. Conductor pipe installation would include pushing, and no pile driving is planned. In addition to the previously discussed dredging methods (trailing suction hopper dredging and water injection dredging), mechanical dredging may also be considered for use in excavation activities nearshore, at HDD exit pits, which will be in shallower waters depths (< 10 meters). Mechanical dredging differs from the hydraulic dredging in that the dredging is conducted from a stationary barge mounted crane, backhoe, or cable arm with an attached bucket to excavate the bottom-material. Buckets on mechanical dredges typically range in size from 1 to 25 cubic yards (0.8 to 10 cubic meters) and include different designs such as a clamshell, environmental bucket, or excavator (NMFS and GARFO 2019).

Dredging will occur at up to twelve offshore HDD exit pits for the Brayton Point ECC, including four in the Sakonnet River and eight in Mount Hope Bay, directly offshore of the proposed landfall locations. The northern portions of the Brayton Point export cable corridor in the Sakonnet River and Mount Hope Bay are representative of river/estuary surficial conditions of Narraganset Bay, and primarily comprise muddy to sandy sediments in the lower portions of the Sakonnet River, and gravelly mud in the upper portions of Mount Hope Bay. For the Brayton Point and Aquidneck Island intermediate landfall locations, the HDD trajectory is anticipated to be 0.3 miles (0.5 kilometers) in length with a cable burial depth of up to 90 feet (27.4 meters) below the seabed. HDD bores would be separated by a distance of 33 feet (10 meters). The two HVDC cable bundles would be unbundled at landfall. Each HVDC power cable is planned to require a separate HDD, with an individual bore and conduit for each power cable. The Brayton Point ECC and Aquidneck Island landfalls would include up to four power cables for a total of up to four boreholes at each landfall site (12 total HDDs – 4 at entry to Aquidneck Island, 4 at exit of Aquidneck Island, and 4 at Brayton Point landfall). The two communications cables would be installed within the same bore as a power cable, likely within a separate conduit. Within each of the three Brayton Point ECC HDD areas, the four HDD exit pits are anticipated to have a dredged volume of 1,867 cubic yards (1,427 cubic meters) per pit for a total of 7,468 cubic yards (5,710 cubic meters) per HDD area and 22,404 cubic yards (17,124 cubic meters) for the Brayton Point ECC as a whole. Water injection dredging is the proposed methodology for excavation at HDD exit pits but other options are still being considered. Excavated material at the HDD exit pits (seaward end of the HDDs) are planned to be side cast on the seafloor adjacent to the excavation areas and allowed to naturally backfill the offshore HDD work areas. This ensures that there are not two sedimentation events occurring at each pit location.

For the Falmouth ECC, dredging will occur at up to four HDD exit pits, directly offshore of the proposed landfall location. Seabed sediment within the Falmouth ECC consists of sand and muddy sand, coarse sediment, mixed sediment, and glacial till. For the Falmouth landfall locations, the HDD trajectory is anticipated to be 0.9 miles (1.5 kilometers) in length with a cable burial depth of up to 90 feet (27.4 meters) below the seabed. HDD boreholes would be separated by a distance of 33 feet (10 meters). Each offshore export cable is planned to require a separate HDD, with an individual bore and conduit for each export cable. The Falmouth ECC would include up to four power cables with up to four boreholes at each landfall site (four total HDDs). The one communications cable would be installed within the same bore as one of the power cables, likely within a separate conduit. Seabed disturbances from HDD exit pits for landfall locations are shown in Table 3.1-13.

Table 3.1-13. Area of disturbance at HDD exit pits for landfall locations

Sea-to-Shore HDD	Area Disturbed, Acre (Hectare)
Falmouth	
Exit Pit /cofferdam (per HDD)	0.10 (0.04)
Total Area Disturbed (4 HDDs)	0.40 (0.16)
Brayton Point/Aquidneck Island	
Exit Pit /cofferdam (per HDD)	0.30 (0.12)
Total Area Disturbed (12 HDDs)	3.6 (1.45)

Source: adapted from COP Volume 1, Tables 3-34 and 3-35; SouthCoast Wind 2023.

3.1.2.4.3.3 Operation and Maintenance

Offshore export cable maintenance near the HDD exit points would be the same as described previously for the offshore export cables.

3.1.2.4.4 Onshore Cables

From the landfall site options, the underground onshore export cables would be routed to a new onshore substation in Falmouth, Massachusetts, and up to two onshore converter stations in Somerset, Massachusetts (Figure 3.1-1). The underground Falmouth onshore export cables would consist of up to four circuits with three, single-core cables per circuit, for a total of 12 onshore export power cables. Additionally, there would be up to four smaller insulated single-core ground continuity cables for carrying fault currents, and up to five communications cables containing fiber optics (one per circuit plus one dedicated communications cable). Several onshore cable route options are under consideration from the potential landfall site to one of two onshore substation options (Figure 3.1-1):

- Lawrence Lynch Substation (preferred): Worcester Avenue (2.0 miles [3.3 kilometers]), Shore Street (2.3 miles [3.6 kilometers]), Central Park (2.2 miles [3.5 kilometers])
- Cape Cod Aggregates Substation Site (alternate): Worcester Avenue (5.9 miles [9.4 kilometers]), Shore Street (6.4 miles [10.25 kilometers]), Central Park (6.1 miles [9.8 kilometers])

The underground Brayton Point onshore export cables would consist of up to four onshore export power cables. Additionally, there would be up to two communications cables containing fiber optics. Two onshore route options are under consideration from the landfall site to the converter station, and three route options are under consideration at the intermediate landfall at Aquidneck Island (Figure 3.1-1):

- Brayton Point Converter Station: Western (0.6 miles [1 kilometer]), Eastern (0.4 miles [0.6 kilometers])
- Aquidneck Island: All three route options are approximately 3 miles (4.8 kilometers)

The onshore export cables would be installed within existing roadways through open cut trenches. Construction of the onshore substation and converter station and cable installation onshore of the landfalls are not expected to affect ESA-listed species under NMFS jurisdiction. Therefore, these onshore activities are not considered further in this BA.

3.1.2.5 Unexploded Ordnance

SouthCoast Wind is conducting a three-phase UXO study to assess possible UXO presence and impact within the Lease Area and ECCs. Phase one, which has been completed, included a desktop study on publicly available data covering the full Project area including both the Lease Area and the ECCs. Based on the conclusions of the research and risk assessment undertaken, a varying low and moderate risk of encountering UXO on site was found (Figure 3.1-16). The risk is moderate throughout all of the Lease Area, and a relatively equal ratio between low and moderate within the ECCs. The identified risk is primarily due to the presence of Allied HE Bombs, Torpedoes, and Depth Charges. Phase two will include a further study in areas of potential interest identified during phase one and utilizes select available survey data. The final phase includes identification of any potential areas of further interest and data gaps. Additionally, phase three will present suggestions for the path forward on further reducing risk to as low as reasonably practicable, consistent with standard industry practice, prior to construction activities.

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

To detonate a UXO, a small charge would be placed on the UXO and detonated, causing the UXO itself to then detonate. The exact number and type of UXOs in the Project area are not yet known, but SouthCoast Wind conservatively estimates that up to five UXOs in the Lease Area and up to five along the ECCs may have to be detonated in place. To avoid times when marine mammal species are more likely to be present, UXO detonations are only planned to occur from May through November. If required, UXO detonations would occur starting in Quarter (Q) 2 2025 and occur periodically through Q2 2030, corresponding to WTG/OSP foundation installation and cable installation.

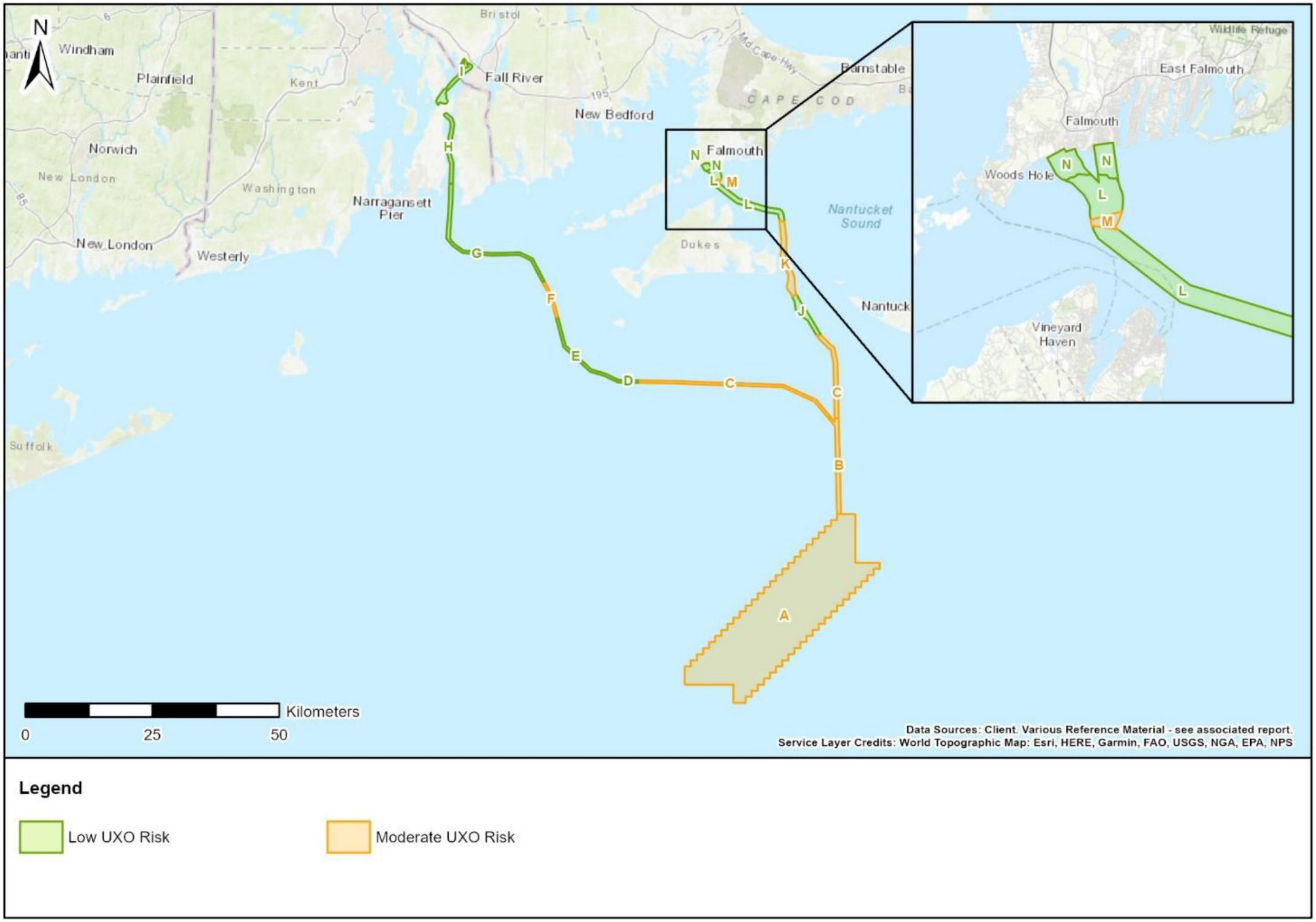


Figure 3.1-16. UXO risk in Lease Area and ECCs

3.1.2.6 Vessel and Aircraft Types and Usage

Table 3.1-14 identifies the ports and estimated number of vessel trips by port that may be used during construction, O&M, and decommissioning. During construction, SouthCoast Wind would receive equipment and materials to be staged and loaded onto installation vessels at one or more existing third-party port facilities. The following ports may be used to support construction activities for the Project: New Bedford, Fall River, and Salem, Massachusetts; Davisville and Providence, Rhode Island; New London, Connecticut; Sparrows Point, Maryland; Charleston, South Carolina; Corpus Christi, Texas; as well as some international ports. Project components may be delivered from international ports including ports in Mexico (Altamira), Canada (Sheet Harbor, Sydney, Argentia), Europe, Asia, and including vessel transits via the Panama Canal. Entry points into the Project area would include vessels transiting from the north from the ports of Sheet Harbor, Argentia, and Sydney in Canada, from the west for ports in Europe or the Middle East/Asia, and from the south for ports in Mexico and Asia (via the Panama Canal). While specific ports have not been identified where equipment and components may originate, SouthCoast Wind anticipates Project components (e.g., WTG monopile and OSP foundations, export cables, etc.) could be fabricated in the U.S., Europe, Asia, and/or the Middle East and then delivered directly to the OCS site. Some Project components, such as WTG components, due to pre-staging requirements, would first be shipped to a port in the U.S. or Canada for marshalling before transiting to the Project area. Ports in the Gulf of Mexico, including Port of Corpus Christi, Texas and Port of Altamira in Mexico, may be used for transportation of components and equipment to the Project site. Vessels originating from these distant ports consist mainly of barges that are expected to transit at a maximum speed of 6 knots through the Gulf of Mexico and 6.5 knots north of Miami. Single transit durations for these ports to the Project site are approximately 15 days from the Port of Altamira and 14 days from the Port of Corpus Christi.

It is estimated that the Project would require approximately 15–35 vessels per day on average during construction, with an expected maximum peak of 50 vessels in the Lease Area at one time, depending on activities. Vessel activity for decommissioning is anticipated to be similar to construction. In addition, aircraft use is expected during construction and decommissioning activities to transport crew and equipment to and from the Lease Area, and drones may be used similarly for part delivery, or substructure and WTG inspections. The same ports are anticipated to be used for decommissioning as for construction, except SouthCoast Wind does not anticipate vessel trips from the ports of Davisville, Rhode Island; Sparrows Point, Maryland; Charleston, South Carolina; or Altamira, Mexico. Anticipated vessel utilization parameters during construction and decommissioning, including estimated work duration and number of vessel trips, are provided in Table 3.1-15.

Probable vessels used to transport and install WTGs and OSPs, with their associated foundations, include heavy lift crane vessels, heavy transport vessels, jack-up vessels, DP vessels, scour protection installation vessels, crew transport vessels, and multipurpose support vessels (Table 3.1-15). Heavy lift crane and transport vessels would be used to transport foundations, WTG components, and OSP topsides. Jack-up vessels, DP vessels, and service operation vessels (SOVs) would be used for installation of the WTG and OSP foundations, WTG components and OSPs, and scour protection installation vessels would be used for installation of scour protection. Additional barges, and accompanying tugboats, may be used for transporting other construction materials. Crew transport vessels (CTVs) would be used to rotate construction crews to and from area ports. Probable vessels used to transport and install the interarray and offshore export cables include carousel- or static tank-equipped cable lay vessels, dedicated cable transport and lay vessels, and cable lay barge (Table 3.1-15).

During construction, continuous nighttime vessel lighting and construction area lighting would be required at the offshore location where the vessel and personnel are working. During transit and nighttime/low-visibility conditions, vessels would, at minimum, use navigation and deck lighting as required by the USCG and other applicable agencies and permit approval conditions, as necessary. During construction activities, the vessels will be illuminated to provide safe working conditions for personnel, as dictated by the operations ongoing at that time. These directed work lights are generally directed downwards onto the required work area, be it a vessel deck, monopile, WTG, OSP, or other, to provide required illumination for personnel or ongoing operations. The placements and intensity of lighting will be determined utilizing the API14F, EN 12464 or equivalent standard such that the lighting scheme provides safe illumination for personnel and minimizes direct and/or indirect lighting of the water surface and/or surrounding environment to the extent practicable.

O&M vessel trips would originate primarily from the ports of New Bedford and Fall River, Massachusetts; Providence, Rhode Island; and New London, Connecticut, with the potential for occasional repair and delivery trips originating from ports in Davisville, Rhode Island; Salem, Massachusetts; Sparrows Point, Maryland; and Charleston, South Carolina (Table 3.1-14). Current generalized vessel transit estimates are conservatively between 1–3 trips daily, with likely up to 500 trips per year from O&M ports to support activities which include survey, cable repair, crew transfer, fuel, and service vessel movement, in addition to the SOV. During O&M activities, service technicians would be delivered to the Lease Area by service operations vessels and CTVs. The ROVs, tugs, and other vessels would be used for repair and maintenance activities, as described in Table 3.1-16.

Table 3.1-17 provides additional information on the vessel type, maximum speed, expected duration, and number of transits for each port under consideration.

Table 3.1-14. Potential Proposed Action ports and approximate number of vessel trips per port for each Project phase

Ports	Number of vessel trips per Project phase		
	C [1]	O&M [2]	D [3]
Port of New Bedford, Massachusetts, USA	1,125	8,066	931
Port of Davisville, Rhode Island, USA	162	284	N/A
Port of Providence, Rhode Island, USA	387	635	377
Port of New London, Connecticut, USA	1,491	8,540	1,113
Port of Fall River area, Massachusetts, USA	929	2,390	554
Port of Salem, Massachusetts, USA	15	117	618
Sparrows Point Port, Maryland, USA*	8	2	N/A
Port of Charleston, South Carolina, USA*	8	2	N/A
Port of Corpus Christi, Texas, USA*	35	N/A	9
Port of Altamira, Tamaulipas, MEX*	36	N/A	N/A
Entry Point into U.S. Waters, vessels transiting from			
Canada (includes Sheet Harbor, Port of Sydney, Port of Argentia)	109	21	55
Panama Canal[4]	3	N/A	7
Europe & Asia	64	37	55

C = construction / marshalling port; O&M = operations and maintenance port; D = decommissioning port; N/A = not applicable.
Anticipated duration in calendar year for each phase of the Project over which these vessel trips would occur:
[1] Construction: 5 years for offshore construction (total for both Project 1 and 2 combined)
[2] O&M: up to 33 years (per Project)
[3] Decommissioning: up to 5 years (total for both Project 1 and 2 combined)

[4] Indicates low likelihood and/or minimal use of ports

Note: A higher percentage of the total anticipated vessel trips per vessel type were allotted to ports that have a higher chance of being selected. To avoid significantly overestimating of the number of trips per vessel type, trips were not duplicated for the scenarios where multiple ports are under consideration. Where multiple ports are considered to have a high chance of selection, additional trips were added to those ports per vessel type to ensure SouthCoast Wind did not significantly underestimate the potential vessel trips from that port.

Source: Information provided by SouthCoast Wind in support of ESA consultation

Table 3.1-15. Estimated Proposed Action vessel and aircraft use parameters for SouthCoast Wind offshore wind farm and export cable construction and decommissioning

Vessel / Aircraft Type	Activity	No. of Each Type of Vessel / Aircraft	Vessel / Aircraft Length (meters)	Vessel Beam (meters)	Vessel Draft (meters)	Vessel Deadweight Tonnage (metric tons)	Operational Speed / Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (1–way)[1]	Estimated Number of Nautical Miles Traveled (for entire buildout)	Potential Ports to be Used During Construction (C) and Decommissioning (D)
								Federal Waters	Massachusetts Waters	Rhode Island Waters			
Airplane	Mammal watch, general support	1–2	10 –15	N/A	N/A	N/A	100–120	240	240	130	260	42,640	Plymouth Regional Airport (C,D) New Bedford Regional Airport (C,D) Groton – New London Airport (C,D)
Anchor Handling Tug	Anchor handling, general support	1–10	50–90	12–18	5–8	Up to ~2,500	10/15	30	240	240	16	4,288	Port of New Bedford (C,D) Port of Providence (C,D) Port of New London (C,D) Port of Fall River (C) Port of Salem (D)
Cable Lay Barge	Transportation and installation of cable and/or dredging (shallow water sections	1–3	40–130	15–35	2–6	Currently unknown	<5/15	30	420	420	20	10,200	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C,D) Sparrows Point Port (C) Port of Charleston (C) Port of Salem (D)
Cable Transport and Lay Vessel	Transportation and installation of export cable and interarray and/or cable burial activities	1–5	118–165	28–35	5–9	Up to ~20,000	2/11.5	990	110	108	88	30,248	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C,D) Sparrows Point Port (C) Port of Charleston (C) Port of Salem (D) US, European, or Canadian ports (C) - location unknown at this time
Crew Transfer Vessel	Commissioning, crew transport, general operations, environmental monitoring and marine mammal observers	2–5	25–40	8–12	1–2.5	50	10/35	2,690	2,690	2,400	1,608	294,532	Port of New Bedford (C,D) Port of New London (C,D) Port of Fall River (C,D)
Dredging Vessel	Seabed preparation, inspection, mattress installation, general support	1–5	90–230	20–45	5–18	5,500 – 80,000	2/15	100	20	20	100	20,930	Port of New London (C,D) Port of New Bedford (C) Port of Providence (C) Port of Salem (D) US, European, or Canadian ports (C) - location unknown at this time
Drones (Fixed wing, single and/or multi-rotor)	Onsite inspection, marine mammal monitoring and identification	1–5	1.25	1–3	N/A	N/A	0–100	800	84	84	12	1,608	N/A

Vessel / Aircraft Type	Activity	No. of Each Type of Vessel / Aircraft	Vessel / Aircraft Length (meters)	Vessel Beam (meters)	Vessel Draft (meters)	Vessel Deadweight Tonnage (metric tons)	Operational Speed / Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (1–way)[1]	Estimated Number of Nautical Miles Traveled (for entire buildout)	Potential Ports to be Used During Construction (C) and Decommissioning (D)
								Federal Waters	Massachusetts Waters	Rhode Island Waters			
Heavy Lift Crane Vessel	Transport, transfer and installation of Substructures, WTG, OSP(s) and related components	1–5	130–385	45–125	4–32	Up to ~22,000	0/15	1,130	90	90	70	25,076	Not anticipated in port; round trips are to safe waters during storm events and entry from Foreign location to OCS Site
Heavy Transport Vessel	Transportation of substructures, WTG, OSP(s) and other project components	1–20	140–300	23–70	5.5–12	Up to ~60,000	12/15	650	30	30	65	67,086	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Davisville (C) Port of Altamira (C) Port of Salem (D) US, European, or Canadian ports (C) - location unknown at this time
Helicopter	Crew changes, part transport, general support	1–4	16	N/A	N/A	N/A	100–145	365	365	290	348	49,648	Plymouth Regional Airport (C,D) New Bedford Regional Airport (C,D) Groton – New London Airport (C,D)
Jack-up Accommodation Vessel	Commissioning activities	1–2	50–151	42–72	4–10	Currently unknown	0/15	960	50	50	14	22,258	Not anticipated in port; round trips are to safe waters during storm events and entry from Foreign location to OCS Site
DP Accommodation Vessel	Commissioning activities	1–2	100–110	65–95	5.5–17	Currently unknown	0/15	1,440	30	30	16	23,028	Not anticipated in port; round trips are to safe waters during storm events and entry from Foreign location to OCS Site
Multipurpose Support Vessel	Seabed preparation, inspection, mattress installation, diving, general support, environmental monitoring and marine mammal observers, noise mitigation, pre- and post-installation inspection surveys	1–8	12–100	5–25	1.5–10	Currently unknown	10/15	4,300	3,000	3,000	660	161,604	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C,D) Port of Davisville (C) Port of Salem (D)
Scour Protection Installation Vessels	Scour protection installation	1–2	135–175	30–40	6–9.5	Up to ~20,000	2/15	400	40	40	40	13,600	Port of Salem (C,D) Port of New London (C) US, European, or Canadian ports (C) - location unknown at this time
Service Operations Vessel	Commissioning using SOV, general operations	1–4	60–100	15–25	1.5–5	1,700 – 4,500	10/25	1,610	300	300	480	91,200	Port of New Bedford (C,D) Port of New London (C,D)

Vessel / Aircraft Type	Activity	No. of Each Type of Vessel / Aircraft	Vessel / Aircraft Length (meters)	Vessel Beam (meters)	Vessel Draft (meters)	Vessel Deadweight Tonnage (metric tons)	Operational Speed / Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (1–way)[1]	Estimated Number of Nautical Miles Traveled (for entire buildout)	Potential Ports to be Used During Construction (C) and Decommissioning (D)
								Federal Waters	Massachusetts Waters	Rhode Island Waters			
													Port of Providence (C,D) Port of Fall River (C,D) Port of Davisville (C) Port of Salem (C,D)
Survey Vessel	Specialized survey work, if required	1–5	28–75	6.5–12	4–7	Currently unknown	2/12	120	24	24	26	8,840	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C) Port of Salem (C,D)
Tugboat	Transportation to site from staging port, port operations	1–12	30–90	10–13	3–7	Up to ~2,700	5/16	5,460	5,460	5,460	655	207,286	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C) Port of Davisville (C) Port of Corpus Christi (C) Port of Altamira (C) Port of Salem (C,D)
Barge	Transportation of components to Site from staging port	1–6	76–146	15–33	3.65–9	Currently unknown	N/A	2,640	2,640	2,640	510	159,684	Port of New Bedford (C,D) Port of New London (C,D) Port of Providence (C,D) Port of Fall River (C) Port of Davisville (C) Port of Corpus Christi (C) Port of Altamira (C) Port of Salem (C,D)
Total								**23,955**	**15,833**	**15,356**	**4,976**	**1,232,148**	

Source: modified from COP Volume 1, Table 3-21; SouthCoast Wind 2023 with supplemental information provided by SouthCoast Wind in support of ESA consultation
N/A = not applicable
[1] Vessel trips are provided for construction. Estimated trips during decommissioning are anticipated to be approximately the same as during construction, where a decommissioning port is identified in the far right column.

Table 3.1-16. Estimated Proposed Action vessel and aircraft use parameters for SouthCoast Wind offshore wind farm and export cable operation and maintenance

Vessel / Aircraft Type	Activity	No. of Each Type of Vessel/Aircraft	Vessel/ Aircraft Length (meters)	Vessel Beam (meters)	Vessel Draft (meters)	Vessel Deadweight Tonnage (metric tons)	Operational Speed/Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (1–way)	Estimated Number of Nautical Miles Traveled (for entire buildout)	Potential Ports to be Used During Operation and Maintenance
								Federal Waters	Massa-chusetts Waters	Rhode Island Waters			
Maintenance Crew/CTVs	Crew and technician transfer	1–4	25–40	8–12	1–2.5	50	10/35	15,015	15,015	15,015	15,015	2,614,260	Port of Fall River Port of New Bedford Port of New London
Multipurpose Support Vessel/SOV	Supply and support	1	12–100	5–25	1.5–5	1,700 – 4,500	10/25	6,420 (MP support)/ 15,015 (SOV)	3,997.5 (MP support)/ 1,584 (SOV)	3,997.5 (MP support)/ 1,584 (SOV)	1980 (MP support)/1,638 (SOV)	530,640 (MP support)/311,220 (SOV)	Port of Fall River Port of New Bedford Port of New London Port of Providence Port of Davisville
Anchor Handling Tugs	Cable inspection and repairs	1–2	50–90	12–18	5–8	Up to ~2,500	10/15	2,970	792	792	250	47,500	Port of Fall River Port of Providence Port of New Bedford Port of New London
ROV	Foundation inspections	1–2	N/A	N/A	N/A	N/A	2/5	2,700	2,700	2,700	N/A	N/A	N/A
Heavy Lift/Jack Up Vessel with Crane	Large scale repairs	1–2	130–385	45–125	4–32	Up to ~22,000	0/12.5	2,970	231	231	33	14,256	Not anticipated in port; round trips are to safe waters during storm events
Scour Vessel or Barge	Scour top-up	1	135–175	30–40	6–9.5	Up to ~20,000	2/15	100	10	10	10	3,400	Port of New London Port of Salem
Inspection/Survey Vessel (Potentially ROV)	Inspection of cables or for surveys	1–2	28–75	6.5–12	4–7	Currently unknown	10/14	1,500	1,282.5	1,282.5	660	176,880	Port of Fall River Port of New Bedford Port of New London Port of Providence Port of Davisville
Self-Propelled ROV/AUV	Inspections, repairs	1–2	N/A	N/A	N/A	N/A	6	8,100	900	900	N/A	N/A	N/A
Helicopter	Crew support or small supply delivery	1–2	16	N/A	N/A	N/A	100–145	1,980	1,980	1,980	1,980	324,720	New Bedford Regional Airport Groton – New London airport, CT
Drone	Future potential for inspection or parts delivery	1–4	1.25	1–3	N/A	N/A	0–100	2,700	0	0	0	N/A	N/A
Cable Transport and Lay Vessel	Transportation and installation of export cable and interarray and/or cable burial activities	1-5	118-165	28-35	5-9	Up to ~20,000	2-11.5	930	110	108	25	17,130	Port of New Bedford Port of New London Port of Providence Port of Fall River Sparrows Point Port of Charleston
Barge	Transportation to site from staging port, port operations	1-6	76-146	15-33	3.65-9	Currently unknown	1-6	880	492	492	150	31,390	Port of New Bedford Port of New London Port of Providence Port of Fall River Port of Salem

Vessel / Aircraft Type	Activity	No. of Each Type of Vessel/Aircraft	Vessel/ Aircraft Length (meters)	Vessel Beam (meters)	Vessel Draft (meters)	Vessel Deadweight Tonnage (metric tons)	Operational Speed/Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (1–way)	Estimated Number of Nautical Miles Traveled (for entire buildout)	Potential Ports to be Used During Operation and Maintenance
								Federal Waters	Massa-chusetts Waters	Rhode Island Waters			
Tugboat	Transportation to site from staging port, port operations	1-12	30-90	10-13	3-7	Up to ~2,700	5-16	908	512	512	300	102,000	Port of New Bedford Port of New London Port of Providence Port of Fall River Sparrows Point Port of Charleston
							Total	**86,008**	**37,792**	**36,206**	**27,882**	**5,431,818**	

Source: modified from COP Volume 1, Table 3-23; SouthCoast Wind 2023 with supplemental information provided by SouthCoast Wind in support of ESA consultation
N/A = not applicable

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Table 3.1-17. Details of vessel trips by port for each vessel type under consideration

Vessel / Aircraft Type	Potential North American Ports to be Utilized During Construction	Vessel Speed/Min Speed (knots)	Vessel Speed/Max Speed (knots)	Max time (Hrs.) (Slowest speed)	Min time (Hrs.) (Fastest speed)
Airplane	Plymouth regional Airport, MA, USA	100	120	0.8	0.6
	New Bedford regional Airport, MA, USA			0.7	0.6
	Groton - New London Airport, CT, USA			0.9	0.7
Anchor Handling Tug	Port of New Bedford, USA	10	15	7.0	4.7
	Port of New London, USA			9.0	6.0
	Port of Providence, USA			8.5	5.7
	Port of Fall River area, USA			9.5	6.4
Cable Lay Barge	Port of New Bedford, USA	1	15	70.0	4.7
	Port of New London, USA			90.0	6.0
	Port of Providence, USA			85.0	5.7
	Port of Fall River area, USA			95.0	6.4
	Sparrows Point Port, USA			490.0	32.7
	Port of Charleston, USA			690.0	46.0
Cable Transport and Lay Vessel	Port of New Bedford, USA	1	11.5	70.0	6.1
	Port of New London, USA			90.0	7.9
	Port of Providence, USA			85.0	7.4
	Port of Fall River area, USA			95.0	8.3
	Sparrows Point Port, USA			490.0	42.7
	Port of Charleston, USA			690.0	60.0
	Europe & Asia Entry point into US waters			216.0	18.8
Crew Transfer Vessel	Port of New Bedford, USA	10	35	7.0	2.0
	Port of New London, USA			9.0	2.6
	Port of Fall River area, USA			9.5	2.8

Vessel / Aircraft Type	Potential North American Ports to be Utilized During Construction	Vessel Speed/Min Speed (knots)	Vessel Speed/Max Speed (knots)	Max time (Hrs.) (Slowest speed)	Min time (Hrs.) (Fastest speed)
Dredging Vessel	Port of New Bedford, USA	1	15	70.0	4.7
	Port of New London, USA			90.0	6.0
	Port of Providence, USA			85.0	5.7
	Canada Entry point into US waters			169.0	11.3
	Europe & Asia Entry point into US waters			216.0	14.4
Drones (Fixed wing, single and/or multi-rotor)	N/A				
Heavy Lift Crane Vessel	Canada Entry point into US waters	1	15	169.0	11.3
	Europe & Asia Entry point into US waters			216.0	11.3
	Panama Canal entry point into US waters			170.0	11.4
Heavy Transport Vessel	Port of New Bedford, USA	12	15	5.9	4.7
	Port of New London, USA			7.5	6.0
	Port of Providence, USA			7.1	5.7
	Port of Davisville, USA			6.3	5.0
	Canada Entry point into US waters			14.1	11.3
	Europe & Asia Entry point into US waters			18.0	14.4
	Altamira, MEX			180.6	144.5
Helicopter	Plymouth regional Airport, MA, USA	100	145	0.8	0.5
	New Bedford regional Airport, MA, USA			0.7	0.5
	Groton - New London Airport, CT, USA			0.9	0.6
Jack-up Accommodation Vessel	Canada Entry point into US waters	1	15	169.0	11.3
	Europe & Asia Entry point into US waters			216.0	14.4
DP Accommodation Vessel	Port of Corpus Christi, USA	8	15	287.7	153.4
	Canada Entry point into US waters			21.2	11.3
	Europe & Asia Entry point into US waters			27.0	14.4

Vessel / Aircraft Type	Potential North American Ports to be Utilized During Construction	Vessel Speed/Min Speed (knots)	Vessel Speed/Max Speed (knots)	Max time (Hrs.) (Slowest speed)	Min time (Hrs.) (Fastest speed)
Multipurpose Support Vessel	Port of New Bedford, USA	10	15	7.0	4.7
	Port of New London, USA			9.0	6.0
	Port of Providence, USA			8.5	5.7
	Port of Fall River area, USA			9.5	6.4
	Port of Davisville, USA			7.5	5.0
Scour Protection Installation Vessels	Canada Entry point into US waters	8	15	21.2	11.3
	Port of Salem, USA			21.3	11.4
	Port of New London, USA			11.3	6.0
Service Operations Vessel	Port of New Bedford, USA	10	25	7.0	2.8
	Port of New London, USA			9.0	3.6
	Port of Providence, USA			8.5	3.4
	Port of Fall River area, USA			9.5	3.8
	Port of Davisville, USA			7.5	3.0
Survey Vessel	Port of New Bedford, USA	2	15	35.0	4.7
	Port of New London, USA			45.0	6.0
	Port of Providence, USA			42.5	5.7
	Port of Fall River area, USA			47.5	6.4
	Port of Salem, USA			85.0	11.4
Tugboat	Port of New Bedford, USA	5	16	14.0	4.4
	Port of New London, USA			18.0	5.7
	Port of Providence, USA			17.0	5.4
	Port of Fall River area, USA			19.0	6.0
	Port of Davisville, USA			15.0	4.7
	Altamira, MEX			433.4	135.5
	Port of Corpus Christi, USA			460.2	143.9

Vessel / Aircraft Type	Potential North American Ports to be Utilized During Construction	Vessel Speed/Min Speed (knots)	Vessel Speed/Max Speed (knots)	Max time (Hrs.) (Slowest speed)	Min time (Hrs.) (Fastest speed)
Barge	Port of New Bedford, USA	1	6	70.0	11.7
	Port of New London, USA			90.0	15.0
	Port of Providence, USA			85.0	14.2
	Port of Fall River area, USA			95.0	15.9
	Port of Davisville, USA			75.0	12.5
	Altamira, MEX			2167.0	361.2
	Port of Corpus Christi, USA			2301.0	383.5

Source: Information provided by SouthCoast Wind in support of ESA consultation
Hrs = hours; N/A = not applicable

3.1.2.7 Pre- and Post-Construction Surveys

SouthCoast Wind has proposed a variety of survey methods to evaluate the effect of construction and O&M on benthic habitat structure and composition and economically valuable fish and invertebrate species. SouthCoast Wind will be working with the University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST) and the Anderson Cabot Center of Ocean Life at the New England Aquarium to conduct baseline studies of existing fisheries in and around the Lease Area and establish monitoring plans for pre-construction, construction, operations, and decommissioning phases of the Project. SouthCoast Wind is working with SMAST, the Anderson Cabot Center, and federal and state agencies to prepare fisheries monitoring plans that are aligned with BOEM guidelines (BOEM 2019b), and additional recommendations provided by the Responsible Offshore Science Alliance (ROSA) Fisheries Monitoring Working Group. These plans incorporate coordination with neighboring lease holders and agencies' research and monitoring efforts, leverage existing surveys and control sites based on previous work conducted by both institutes, and provide adaptability and flexibility to adjust as new information is learned and/or new regional programs are established.

The surveys proposed include HRG surveys, fisheries surveys, and benthic habitat monitoring surveys. Currently, SouthCoast Wind does not intend to deploy any metocean buoys pre- or post- construction. A metocean buoy, as part of the site assessment phase, was previously deployed but has since been decommissioned. Details of the metocean buoy and deployment methods can be referenced in SouthCoast Wind's Site Assessment Plan (Mayflower Wind 2019). Moored passive acoustic monitoring (PAM) systems or mobile PAM platforms such as towed PAM, autonomous surface vehicles, or autonomous underwater vehicles may be used prior to, during, and following construction. PAM devices may be required in the COP, through USACE permits, under the MMPA LOA, or required as a condition of the biological opinion. PAM data may be used to characterize the presence of protected species, specifically marine mammals, through passive detection of vocalizations; to record ambient noise and marine mammal and cod vocalizations in the Lease Area before, during, and after construction to monitor project impacts relating to project activities in the Lease Area. In addition to specific requirements for monitoring surrounding the construction period, periodic PAM deployments may occur over the life of the Project for other scientific monitoring needs. A detailed description of the real-time PAM system will be developed and submitted to NMFS and BOEM closer to the start of construction.

3.1.2.7.1 High-Resolution Geophysical (HRG) Surveys

Prior to construction, one or more pre-installation surveys of the cable routes will be conducted. This survey will utilize sonar, sub-bottom profilers, echo-sounder, and/or magnetometer equipment to create images and collect data on features present on the seafloor and within the subsurface. These surveys will further inform installation and protection methods to be applied to the cables, aid in avoiding potential seafloor and subsurface hazards, and identify any anomalies or changes from prior surveys.

HRG surveys will be conducted intermittently during construction (2 of the 5 years to be covered by SouthCoast Wind's requested incidental take regulations) to identify any seabed debris and provide general construction support. These surveys may use equipment such as multi-beam echosounders (MBES), sidescan sonars (SSS), shallow penetration sub-bottom profilers (SBPs) (e.g., "Chirp", parametric, and non-parametric SBPs), medium penetration sub-bottom profilers (e.g., sparkers), ultra-short baseline positioning equipment, and marine magnetometers. During the construction phase, an estimated 2,485 miles (4,000 kilometers) may be surveyed within the Lease Area and 3,106 miles (5,000 kilometers) along the ECCs in water depth ranging from 6.5 feet (2 meters) to 204 feet (62 meters). A maximum of four total vessels will be used concurrently for surveying. On average, a 50-mile line (80 kilometers) will be surveyed per vessel each day at approximately 3.48 miles/hour (5.6 kilometers/hour and 3 knots). HRG survey operations will occur on a 24-hour basis, although some vessels may only operate during daylight hours (~12-hour survey vessels). While the final survey plans will not be completed until construction contracting commences, HRG surveys are anticipated to operate at any time of year for a maximum of 112.5 active sound source days. During the operations phase of construction (3 of the 5 years to be covered by SouthCoast Wind's requested incidental take regulations), an estimated 1,739.8 miles (2,800 kilometers) may be surveyed in the Lease Area and 1,988.4 miles (3,200 kilometers) along the ECCs each year. Using the same estimate of 50 miles (80 kilometers) of survey completed each day per dedicated survey vessel, approximately 75 days of survey activity would occur each year. Beyond the 5-year duration of the LOA, SouthCoast Wind will conduct any additional G&G surveys as required by BOEM or other relevant agencies. SouthCoast Wind plans to conduct periodic cable inspection surveys, as recommended by the cable manufacturer, which could use a combination of MBES, SSS, visual, and possibly other survey technologies (i.e., synthetic aperture sonar). The exact details, including frequency, of the cable inspection surveys will be determined once a cable manufacturer is selected.

SouthCoast Wind does not currently have any pre- or post-construction geotechnical surveys planned; however, if the specific location of certain Project components differs from the previously surveyed layout, SouthCoast Wind will perform additional geotechnical investigations at any new locations not already covered by previous investigations, as requested by BOEM.

NMFS (2021b) has completed a programmatic consultation addressing the effects of site assessment and characterization activities anticipated to support siting of offshore wind energy development projects off the U.S. Atlantic coast, including HRG and geotechnical surveys. In its consultation, NMFS (2021b) evaluated potential effects of these activities, including effects on individual animals associated with survey noise exposure; effects of environmental data collection, buoy deployment, operation, and retrieval; effects on habitat; and effects of vessel use, and concluded that the site assessment and characterization activities considered are not likely to adversely affect any ESA-listed species or critical habitat. The pre- and post-construction HRG and geotechnical surveys that would be required for the Proposed Action are anticipated to be similar to the programmatic consultation (BOEM 2021e). Any HRG and geotechnical surveys conducted for the Proposed Action would be required to follow BOEM's (BOEM 2021d) Project Design Criteria and Best Management Practices and the 2021 NMFS Letter of Concurrence (LoC) (NMFS 2021c) that were developed to address the mitigation, monitoring, and reporting conditions identified in the programmatic consultation (refer to Section 3.3, Table 3.3-2).

3.1.2.7.2 Fisheries Monitoring Plan

SouthCoast Wind is proposing a comprehensive fisheries monitoring plan to assess potential impacts of the proposed development on marine fish and invertebrate communities within the Lease Area (SMAST 2024). The proposed fisheries monitoring plan incorporates multiple surveys utilizing a range of survey methods to assess different facets of the regional ecology and fisheries. These include a demersal otter trawl survey, benthic optical drop camera survey, and a ventless lobster trap survey.

The experimental design for the fisheries surveys will follow the Before-After-Control-Impact (BACI) design originally proposed by Green (1979), and recommended by BOEM (BOEM 2019b), with principals on environmental sampling as guidance (Underwood 1994, Christie et al 2020). The experimental design will also be set up to coordinate with ongoing large-scale surveys conducted by SMAST and other institutes such as the Virginia Institute of Marine Science (VIMS), NOAA Fisheries, and state fisheries agencies. This structure would enable the development of large-scale Before-After-Gradient (BAG) experimental frame works as well. Following the BACI design, control areas will be designated close to the development area with the goal of comparing catch rates, population structure, community composition, abundance, size distributions, vital biological statistics (sex ratio, condition factor, etc.), and environmental parameters (temperature, salinity, dissolved oxygen, substrate). The current monitoring plan is proposed to be a minimum of five years in duration, including two years of pre-construction baseline monitoring, one year of monitoring during construction, and at least two years for post-construction monitoring, resulting in a balanced BACI design. The surveys to be conducted under the Fisheries Monitoring Plan include:

- Demersal otter trawl: The demersal otter trawl survey, further referred to as a trawl, will be used to evaluate the impacts of development on demersal fish populations. This sampling consists of a net being towed behind a vessel along the seafloor expanded horizontally by a pair of otter boards or trawl doors. The survey trawl will be a 157 x 5 inch (400 x 12 centimeter), three-bridle, four-seam bottom trawl. This net style allows for a high vertical opening, relative to the size of the net, with consistent trawl geometry. These features make it a suitable net to sample a wide diversity of species with varying life history characteristics (i.e., demersal, pelagic, benthic, etc.). To effectively capture benthic organisms a “flat sweep” will be used. This is allowed due to the soft bottom (i.e., sand, mud) in the survey area. To ensure the retention of small individuals, the net will have a five-inch (12-centimeter) diamond mesh cod end with a one-inch (2.5-centimeter) knotless liner. Trawls tend to be relatively indiscriminate in the fish and invertebrates they collect; hence trawls are a general tool for assessing fish communities along the seafloor and are widely used by institutions worldwide for fisheries and ecosystem monitoring.

  The trawl survey area will encompass approximately 199 square miles (515 square kilometers) of SouthCoast Wind’s Lease Area and adjacent control areas of similar size and depths, using a spatially balanced sampling method. Thirty tows will be conducted in the Lease Area, and another 30 tows in the control area. Surveys will be conducted seasonally during Spring (April-June), Summer (July-September), Fall (October-December), and Winter (January-March). Survey trawls will be towed for 20 minutes at each station at 3.0 knots. For each tow, data will be collected on trawl performance, aggregated species weights, individual biological sampling of fish (length, weight, etc.), and environmental conditions (temperature, salinity, weather, etc.). The survey will provide data on catch rates, population structure, and community composition for the environmental assessment using the BACI framework.

- Drop camera: The benthic optical drop camera survey uses the SMAST sampling pyramid that deploys three cameras (digital still and video) and estimates the substrate as well as 50 different invertebrate and fish species that associate with the sea floor. This survey is used in the NOAA stock assessment of the Atlantic sea scallop (*Placopecten magellanicus*) resource. This survey will encompass the development area and multiple control areas of similar size and depths, with a spatially balanced sampling method. There will be 126 stations in the Lease Area and 134 stations in the control areas arranged on a 0.8 square mile (2 square kilometer) grid. Samples will be collected on two surveys that target the spring and late summer (between April and September annually). Still and video imagery will be collected at each station to provide data on species composition, biomass, abundance, and habitat.

  The goal of the drop camera survey is to provide estimates of absolute abundance and species-specific distribution maps for flounders, red hake, crabs, lobster, sea scallops, and skates. In addition, the distribution of animal holes will also be mapped. Fine scale habitat data will be collected, with the percent coverage of surficial substrate types based on the Wentworth scale and structure forming benthic animals will be quantified for the four quadrat images at each sampling site. This station-level information will be aggregated to describe habitat features within and around the development and control areas. Habitat descriptions will follow Coastal and Marine Ecological Classification Standard (CMECS) terminologies. This will provide comparisons of the variation of benthic species and composition of substrate types between the Lease Area, control areas, and broader regions of the U.S. continental shelf.

  A drop camera pyramid will be deployed four times, roughly 164 feet (50 meters) apart, at each station. The pyramid will be equipped with two downward-looking cameras to provide quadrat samples of the seafloor for all stations. Additionally, a third camera with a 6.5 square foot (0.6 square meter) view of the seafloor or a view parallel to the seafloor will also be deployed. At each station, images will be collected for laboratory review. Within each quadrat, epibenthic invertebrates (comprised of 50 total taxa that can include squid egg clusters or other organisms of interest) will be counted or noted as present and the substrate will be identified.

- Ventless trap survey: A ventless trap survey will focus on the American lobster (*Homarus americanus)*, Jonah crabs *(Cancer borealis)*, rock crab *(Cancer irroratus*), and black sea bass (*Centropristis striata*). This work will be conducted in partnership with the Massachusetts Lobstermen's Association. This survey follows the same sampling design as the Massachusetts, Maine, and Rhode Island state ventless trap surveys to allow broader scale comparisons (SMAST 2024). The incorporation of these surveys will provide a holistic assessment of the fisheries resources in the Project area and assess the potential impact of offshore wind energy development. All components of the Fisheries Monitoring Plan are planned to be conducted on board commercial fishing vessels piloted by experienced fishermen. The Fisheries Monitoring Plan has been developed consistent with BOEM guidance on fisheries surveys.

  The survey will sample 30 random depth-stratified stations from May through October with stations distributed throughout the development and control areas in a BACI design. Each trap string contains a total of six pots, alternating between vented and ventless traps that are 40 x 21 x 16 inches (1016 x 533 x 406 millimeters). To the degree possible, survey gear will be hauled on a three-day soak time, in the attempt to standardize catchability among trips. All strings will be reset in the same assigned location after each haul. The proposed sampling periods may vary but two hauling periods per month is the target intensity of this study with gear removed at the end of the survey period in October. Ropeless fishing gear will be deployed during the ventless trap survey, meaning there will be no vertical downlines. The primary method for retrieving trap strings will be grappling, though on-demand systems will continue to be tested and potentially phased into the survey as the technology progresses and becomes logistically feasible.

- Neuston net sampling: In tandem with the ventless trap survey, SouthCoast Wind and its collaborators will plan, coordinate, and conduct a stratified random neuston tow survey to target neustonic American lobster larvae and other large ichthyoplankton in the SouthCoast Wind Lease Area and control areas during the months of May through October. Neuston net sampling will occur twice monthly to assess larval fish, crab, and lobster in the development and control area. The neuston net frame is 7.9 x 2 x 19.7 feet (2.4 x 0.6 x 6 meter) in size and the net is made of a 0.05 inch (1,320 micrometer) mesh. At the end of the net is a cod end for collecting samples. The sampling net will be deployed off the stern of the commercial fishing vessels. At each location one tow at 4 knots of approximately 10 minutes each will be conducted and temperature, tow speed, and set and haul coordinates will be recorded.

  An LOA from NMFS will be obtained to conduct the ventless trap survey. At this time, no special fisheries or ESA-related permits are expected to be required for the neuston net sampling due to the non-intrusive technique.

A fisheries monitoring plan (INSPIRE 2023) has also been developed for the portion of the Brayton Point ECC in Rhode Island state waters in accordance with the Rhode Island Ocean Special Area Management Plan (OSAMP), the Baseline Assessment Requirements in state waters, and other applicable sections of the Rhode Island Code of Regulations to characterize abundance and size structure, as well as presence, movement, and behavior of key fisheries species during the pre-construction, construction, and post-construction phases of the project. The species targeted by monitoring efforts will include the striped bass (*Morone saxatillis*), summer flounder (*Paralichthys dentatus*), tautog (*Tautoga onitis*), false albacore

(*Euthynnus alletteratus*), channeled whelk (*Busycotypus canaliculatus*), and knobbed whelk (*Busycon carica*) using acoustic telemetry and trap surveys as the primary monitoring methodologies.

SouthCoast Wind will conduct acoustic telemetry monitoring in Rhode Island state waters along the Brayton Point ECC at the mouth of the Sakonnet River using a 12-receiver array of fixed station acoustic receivers to monitor the movements, presence, and persistence of several commercially and recreationally important species (e.g., striped bass, summer flounder, tautog, and false albacore). Receivers will be deployed in early spring and retrieved in late fall to ensure seasonal overlap with the target species. Target fish species within the area in and around the receiver array will be captured via rod-and-reel, implanted with acoustic transmitters, and released back into the ocean.

Commercial channel and knobbed whelk landings are reported throughout Narragansett Bay and are especially prevalent in the Sakonnet River, which represented roughly 30 percent of all whelk landings in 2021 (RIDMF 2022). SouthCoast Wind will conduct a BAG trap survey to monitor whelk relative abundance and size structure along commercially fished sections of the Brayton Point ECC in the Sakonnet River. The survey will identify potential impacts from the short-term disturbance of submarine cable installation on the localized channeled and knobbed whelk resources. Sampling frequency will likely occur twice per month from May to November to align with the commercial fishery for whelk within Narragansett Bay, to the extent practicable. Four to six stations will be selected with input from the commercial fishing industry along the Brayton Point ECC in the Sakonnet River. Given the localized effort occurring within the Sakonnet River, SouthCoast will make every effort to minimize impacts to fishing operations. At each of the sampling stations, three six-trap strings will be laid parallel to the export cable and placed at three distance range categories: impact, middle, and furthest. One string will be set on top of the cable as the impact gradient, one string placed 49-98 feet (15-30 meters) from the impact string will act as the middle gradient, and one string 164 feet (50 meters) or greater from the impact string will serve as the furthest gradient. All traps will be rigged with a rope bridal system and separated by 98 feet (30 meters) of groundline when tied to the string, resulting in a groundline length of roughly 492 feet (150 meters). All whelk and bycaught species caught will be separated by species, enumerated, and weighed to obtain catch per unit effort (CPUE) estimates on a per trap basis.

3.1.2.7.3 Benthic Habitat Monitoring Plan

SouthCoast Wind has conducted benthic seafloor habitat and seafloor characterization assessments in the Lease Area and along the proposed ECCs (SouthCoast Wind 2023, Appendix M). This baseline seafloor survey characterized benthic habitats within the Project area possibly affected by the proposed construction and operations to better inform siting decisions with the goal of avoiding or minimizing potential impacts on sensitive biological communities and EFH as required by BOEM 2019a and NMFS 2020 guidelines. Survey methodologies included benthic grab sampling for analysis of physical parameters and benthic community structure, Sediment Profile Imaging/Plan View (SPI/PV) imagery for determining the physical characteristics of surficial sediment and presence of epifauna and other surface-dwelling organisms, and real time video to support and inform reporting according to the CMECS format as required by BOEM guidelines.

SouthCoast Wind has also developed a benthic monitoring plan for benthic habitats within the Lease Area and the Brayton Point ECC to evaluate detectable post-construction changes (INSPIRE 2024). Benthic monitoring will focus on determining changes to the benthic ecosystem associated with the development of the wind farm. Specifically, the monitoring will focus on documenting potential adverse outcomes associated with the introduction of novel surfaces (foundations, scour protection, and cable protection layers) that act as artificial reefs, the artificial reef effect (epifaunal colonization) associated with the offshore wind structures that will lead to enrichment (fining and higher organic content) of surrounding soft bottom habitats resulting in shifts in benthic function (increased organic matter processing), and the physical disturbance of soft sediments and hard bottom during cable installation (including seafloor preparation) that will temporarily disrupt the function of the infaunal community. To assess the effect of the introduction of hard-bottom novel surfaces, a ROV stereo-camera system will be used to measure changes in benthic percent cover, identify key or dominant species, document non-native/invasive species, and compare findings across water depths in a stratified-random sampling design. To evaluate structure-oriented enrichment, sediment grab samples and SPI/PV will be used to measure changes in benthic function over time and with distance from foundations. For this objective, a stratified random selection of foundations within water depth contoured strata will be tested using a BAG design at each selected foundation. SPI/PV will again be used to measure benthic function over time and with distance from the cable centerline to assess cable-associated physical disturbance. A BAG design will be used to evaluate this objective within a stratified-random selection of cable segments.

ROV stereo camera surveys will monitor novel hard bottom habitats within subareas of the Project area, at structures selected using a stratified random design. The selected WTG and OSP foundations will be surveyed from the air-sea interface down to the seafloor and away from the structure to the edge of the scour protection layer using underwater image collection. For each selected foundation, the field team will collect images with a stereo camera. Images with be collected with auxiliary lights, with at least 50 percent overlap for all survey lines, with approximately 3.3-foot (1 meter) stand-off distance, in an overlapping pattern. Surveys will sample four replicate WTGs, randomly selected within each of two depth contour strata, <164 feet (<50 meters) and >164 feet (>50 meters). Surveys will scan and sample these replicate WTGs during each survey event. The hard bottom monitoring will occur in late spring/early fall for each survey. The initial baseline survey will occur during the first late spring/early fall following construction. The survey will then be repeated three years following construction. Results of the three-year post construction monitoring will be reviewed, and additional monitoring will be completed five years post construction, if needed. This would include the detection of invasion by non-native taxa or the lack of recolonization by benthic taxa. The objective of the benthic monitoring is to determine if adverse shifts in benthic function occurs, observing the full recovery of the benthic community is not a goal of this operational monitoring program.

Sediment samples will be collected and analyzed for grain size distribution and organic matter characteristics. Pre-construction transects will begin at the center point of the planned foundation with two stations at equal intervals up to the maximum planned extent of the scour protection area and then at intervals of 0-32 feet, 49-82 feet, 131-164 feet, 295-328 feet, and 2,953 feet (0-10 meters, 15-25 meters, 40-50 meters, 90-100 meters, and 900 meters) extending outward from the edge of the scour protection area. Post-construction transects will repeat this design at the same WTGs and the same sampling distance intervals. At six locations within each habitat type sampling stratum, transects will be positioned perpendicular to the cable route (three replicate transects per habitat stratum and direction). Along each transect within soft bottom benthic habitat types, a total of five stations will be sampled. At each station, triplicate SPI/PV images will be collected and analyzed. Near the centerline these stations will be distributed roughly 32 feet (10 meters) apart and the distance intervals between stations will increase with distance from the centerline.

Within Rhode Island state waters, specific areas are of interest to regulatory agencies where complex habitats occur and boulder movement activities are expected prior to cable installation. These areas include the region northeast of Mount Hope Bridge, the pocket of Glacial Moraine west of Sakonnet Point, and the area near the Rhode Island state waters demarcation. As outlined in the state permitting requirements, targeted studies will be designed to monitor these three areas of interest following boulder relocation and cable installation. These studies will be further developed within the required Boulder Relocation Plan that will be drafted for agency review in accordance with the state permits. It is expected that monitoring in these areas will rely on a combination of video imagery and still imagery to capture any changes in the biological and physical characteristics of the habitat following cable installation.

3.1.2.8 Port Modifications

The Proposed Action does not include port modifications.

3.1.2.9 Decommissioning

BOEM's decommissioning requirements are stated in Section 13, *Removal of Property and Restoration of the Leased Area on Termination of Lease,* of the April 1, 2019, lease for OCS-A 0521. Unless otherwise authorized by BOEM, pursuant to the applicable regulations in 30 CFR Part 285, SouthCoast Wind 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 the leased area, including any project easements(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.

Decommissioning is intended to recover valuable recyclable materials, including steel piles, turbines and related control equipment, and the transmission lines. The decommissioning process involves the same types of equipment and procedures used during Proposed Action construction, absent pile driving, and would have similar impacts on the environment.

In accordance with BOEM requirements, SouthCoast Wind 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 35-year designed service life. Before ceasing operation of individual WTGs or the entire Project and prior to decommissioning and removing project components, SouthCoast Wind would consult with BOEM and submit a decommissioning plan for review and approval. Upon receipt of the necessary BOEM approval and any other required permits, SouthCoast Wind would implement the decommissioning plan to remove and recycle equipment and associated materials. Decommissioning of project components may involve removing their associated chemicals. Alternatively, chemicals may be removed prior to the removal of the Project component. Removal, treatment, and disposal of any chemicals will be completed in accordance with the approved Decommissioning Plan, as well as any federal, state, and local regulations.

The decommissioning process for the WTGs and OSPs, with their associated foundations, is anticipated to be the reverse of installation, with Project components transported to an appropriate disposal and/or recycling facility. All foundations and other Project components would need to be removed 15 feet (4.6 meters) below the mudline, unless other methods are deemed suitable through consultation with the regulatory authorities (Section 2.1), including BOEM. Submarine export and interarray cables would be retired in place or removed in accordance with the BOEM-approved decommissioning plan. SouthCoast Wind would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Project components will be decommissioned using a similar suite of vessels, as described in Section 3.1.2.6.

3.2 Description of IPFs

The Proposed Action would result in various IPFs that could affect ESA-listed species in the Action Area. These IPFs are described in Table 3.2-1. There is no critical habitat designated for any ESA-listed species within the Project area; however, there is critical habitat designated for ESA-listed species within the Action Area, notably NARW foraging ground. Table 3.2-1 describes the IPFs associated with the Proposed Action, identifies the sources or activities that contribute to these IPFs, identifies the listed species that could be exposed to these IPFs (see Section 4 for information on listed species in the Action Area), and differentiates between IPFs that are Not Likely to Adversely Affect (NLAA) and those that may be Likely to Adversely Affect (LAA) listed species or critical habitats.

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Table 3.2-1. IPFs Associated with the Proposed Action mapped to species or critical habitat

IPF	Marine Mammals						Sea Turtles					Elasmobranchs	Fish	Corals	
	Blue Whale	Fin Whale	[1]NARW	Rice's Whale	Sei Whale	Sperm Whale	Green	Hawksbill	Kemp's ridley	Leatherback	[1]Loggerhead	Giant manta ray, Oceanic whitetip shark, [1]Smalltooth sawfish	Atlantic salmon, [1]Gulf sturgeon, [1]Nassau grouper, Shortnose sturgeon	[1]Atlantic Sturgeon	[1]Elkhorn coral, [1]Staghorn coral, Boulder star coral, Lobed star coral, Mountainous star coral, Pillar coral, Rough cactus coral
Underwater & Other Noise															
Impact & Vibratory Pile-Driving	NLAA	**LAA**	**LAA**	--	**LAA**	**LAA**	NLAA	--	NLAA	**LAA**	**LAA**	--	--	NLAA	--
G&G Surveys	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Cable Laying	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Dredging	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
UXO Detonation	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Vessels	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	--
Helicopter & Drones	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
WTGs	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Vessel Traffic															
Risk of Vessel Strike	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**	NLAA	**LAA**	**LAA**	**LAA**	NLAA	NLAA	NLAA	--
Vessel Discharges	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	--
Habitat Disturbance/Modifications															
G&G Surveys	--	--	--	--	--	--	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Fisheries Surveys – Risk of Capture and Entanglement	NLAA	NLAA	NLAA	--	NLAA	NLAA	**LAA**	--	**LAA**	**LAA**	**LAA**	--	--	**LAA**	--
Fisheries Surveys – Effects on Prey and/or Habitat	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Habitat Conversion and Loss – Foundations and Scour Protection	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Habitat Conversion and Loss – Cable Emplacement	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--

IPF	Marine Mammals						Sea Turtles					Elasmobranchs	Fish	Corals	
	Blue Whale	Fin Whale	[1]NARW	Rice's Whale	Sei Whale	Sperm Whale	Green	Hawksbill	Kemp's ridley	Leatherback	[1]Loggerhead	Giant manta ray, Oceanic whitetip shark, [1]Smalltooth sawfish	Atlantic salmon, [1]Gulf sturgeon, [1]Nassau grouper, Shortnose sturgeon	[1]Atlantic Sturgeon	[1]Elkhorn coral, [1]Staghorn coral, Boulder star coral, Lobed star coral, Mountainous star coral, Pillar coral, Rough cactus coral
Habitat Conversion and Loss – Spuds and Anchors	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Turbidity	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Dredging – Direct Effects	--	--	--	--	--	--	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Dredging – Impacts on Prey	--	--	--	--	--	--	--	--	NLAA	--	--	--	--	NLAA	--
Trenching	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Presence of WTGs on Atmospheric / Oceanographic Conditions	--	NLAA	NLAA	--	NLAA	--	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Physical Presence of WTGs on Listed Species	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
EMF and Heat from Cables	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Lighting and Marking of Structures	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Offshore Substations – Water Withdrawal and Discharge	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Offshore Substations – Impacts on Prey	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Other IPFs															
Air Emissions	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	--	--	--	--
Port Modifications[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Repair and Maintenance Activities	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Potential Shifts of Ocean Users	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Vessel Collision/Allision with Foundation	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--

IPF	Marine Mammals						Sea Turtles					Elasmobranchs	Fish		Corals
	Blue Whale	Fin Whale	[1]NARW	Rice's Whale	Sei Whale	Sperm Whale	Green	Hawksbill	Kemp's ridley	Leatherback	[1]Loggerhead	Giant manta ray, Oceanic whitetip shark, [1]Smalltooth sawfish	Atlantic salmon, [1]Gulf sturgeon, [1]Nassau grouper, Shortnose sturgeon	[1]Atlantic Sturgeon	[1]Elkhorn coral, [1]Staghorn coral, Boulder star coral, Lobed star coral, Mountainous star coral, Pillar coral, Rough cactus coral
Failure due to Weather Events	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--
Oil / Chemical Spill	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	NLAA	NLAA	NLAA	--	--	NLAA	--

[1] Critical habitats of these species that occur within the Action Area (NARW, loggerhead sea turtle, Atlantic sturgeon, Gulf sturgeon, Nassau grouper, smalltooth sawfish, elkhorn coral, staghorn coral) were excluded from this summary as the Proposed Action was determined to have **"no effect"** on any of the physical and biological features of these habitats. Other critical habitats do not occur within the Action Area.
[2]Port modifications are not part of the proposed Project.
"—" = no effect, DPS = distinct population segment; EMF = electromagnetic field; G&G = geotechnical and geophysical; IPF = impact-producing factor; LAA = likely to adversely affect; NARW = North Atlantic right whale; NLAA = not likely to adversely affect; OSP = offshore substation platform; UXO = unexploded ordnance; WTG = wind turbine generator

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3.3 Proposed Mitigation, Monitoring, and Reporting Measures

This section outlines the mitigation, monitoring and reporting conditions that are intended to minimize or avoid potential impacts on ESA-listed protected species. Mitigation measures committed to by SouthCoast Wind in the COP are considered a part of the Proposed Action and are binding. For marine mammals, such conditions may also be contained in the LOA from NMFS, which has been applied for under the MMPA by SouthCoast Wind. Conditions would also be required under the ESA consultation process. Notably, the temporal scope of ESA consultation is broader than the LOA and covers the life of the Project, whereas the LOA regulations are valid for 5 years for construction and the initial years of O&M of the Project that may overlap with the construction period. Therefore, the scope of some measures such as vessel strike avoidance conditions and reporting requirements may apply beyond the scope of the LOA. Mitigation measures to which SouthCoast Wind commits as part of the MMPA process will be included as conditions of the final LOA, as may be amended from the proposed conditions, and will be required. A requirement to follow final LOA conditions that apply to ESA-listed whales included in this BA will also be included as a condition in the final ROD. Summaries of mitigation and monitoring measures from the SouthCoast Wind LOA Application (LGL 2024) are provided in Table 3.3-1; these measures reflect the proposed conditions as of May 2024 and are subject to change based on final issuance of the LOA from NMFS as a Co-Action Agency.

During the development of the draft BA, and in coordination with cooperating agencies, BOEM considered additional mitigation measures that could further avoid, minimize, or mitigate impacts from the Proposed Action. These proposed mitigation measures by BOEM are evaluated as part of the Proposed Action and described in Table 3.3-2. Some or all of these BOEM-proposed mitigation measures may be required as a result of consultation completed under Section 7 of the ESA, or through the Magnuson Stevens Act. Mitigation imposed through consultations will be included in the final ROD. The additional mitigation measures presented in Table 3.3-2 may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more additional measures in the record of decision and adopt those measures as conditions of COP approval.

In January 2024, SouthCoast Wind submitted a Supplemental North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving (SouthCoast Wind 2024) to NMFS in response to concerns related to pile driving activities occurring in the Nantucket Shoals region, specifically within the 20 kilometer of the 30-meter isobath on the west side of Nantucket Shoals, which is considered a NMFS area of concern (Figure 3.3-2). This plan intends to supplement the existing applicant-proposed monitoring mitigation measures and includes expanded monitoring coverage of the pre-start clearance and shutdown zones and Level B harassment zones within the NFMS area of concern. Measures in this plan also include SouthCoast Wind's commitment to only use impact pile driving (no vibratory pile driving) during the installation of the foundations associated with Project 1 in the northern portion of the Lease Area (Project 1), which includes all locations within the NMFS area of concern. A summary of the Supplemental North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving is outlined within Table 3.3-1.

BOEM has considered several measures to minimize potential impacts from the Project on species and habitat in Nantucket Shoals, which is an area of high foraging value for several ESA-listed species near the northeastern portion of the Lease Area. These measures identify restrictions on Project activities within an "enhanced mitigation area" of the Lease Area nearest to Nantucket Shoals, as shown in Figure 3.3-1. The enhanced mitigation area was delineated by evaluating the density and abundance of wildlife adjacent to Nantucket Shoals. This analysis included avian abundance, greatest NARW densities (late fall through spring), zooplankton, and chlorophyll a (Curtice et al. 2019; Northeast Ocean Data 2022). For NARW density, the enhanced mitigation area includes all cells containing one animal or more based on right whale density models for February which produced the greatest densities within the Lease Area

(Curtice et al. 2019; Northeast Ocean Data 2022). BOEM has included three measures to be evaluated as part of the Proposed Action, NS-1, NS-2, and NS-4, which are described in Table 3.3-2.

In addition, BOEM is in the process of evaluating the financial feasibility and practicability of two measures (NS-3 and NS-5), which are described below. These potential measures **are not part of the Proposed Action** (i.e., neither proposed by the applicant or any action agencies), but rather are requested to be discussed under further consultation for their effectiveness at reducing take as potential terms and conditions.

- **Potential Measure under Evaluation: NS-3 Vessel-strike avoidance.** A real-time detection and reporting PAM system must be implemented during the construction period. The PAM system must operate in the enhanced mitigation area (Figure 3.3-1) 24 hours per day. The system must be capable of detection of NARW vocalizations, report the detections to a PAM operator in near-real time, and share all detections with NMFS. Upon a confirmed detection of a NARW, all Project construction and crew transfer vessels of all sizes must travel at 10 knots (18.5 kilometers per hour) or less in a 4-square-mile (10-square-kilometer) area around the location of the detection. Speed restriction must remain in place until there are no PAM detections within 48 hours of implementation of the speed restrictions, or daily aerial surveys result in no NARW sightings within 48 hours of implementation of the speed restrictions. This precautionary measure would be in place during offshore construction no matter the time of year when such work is being done. While NARW occurrence around Nantucket Shoals is greatest in the fall and winter, this measure addresses avoidance during offshore construction throughout the year to reduce the potential of any interaction between vessels and NARWs.
- **Potential Measure under Evaluation: NS-5 Pile Driving shut down provisions in enhanced mitigation area.** SouthCoast Wind will be required to implement a real-time monitoring system (PAM or aerial imagery) capable of detecting and localizing the direction of NARW calls around foundation installation in the enhanced mitigation area (Figure 3.3-1). The system must be able to detect NARWs within the permanent threshold shift (PTS) and behavioral harassment distances modeled or modified through approved sound field verification measurements. If a NARW is detected within the PTS and behavioral harassment distances from impact or vibratory pile driving, subsequent pile driving shall be temporarily suspended. Pile driving may not commence until acoustic monitoring or visual surveillance confirms no NARW occurrence within these distances for a continuous 48 hours.

Table 3.3-1. Mitigation, monitoring, and reporting measures as proposed in the Petition for Incidental Take Regulations (ITR) for the Construction and Operations of the SouthCoast Wind Project submitted to NMFS

Application	Measure	Description	Project Phase	Expected Effects
Applies to All Project Activities	Protected Species Observer (PSO) and Acoustic Protected Species Observer (APSO) Experience and Responsibilities	Protected Species Observers (PSO), Acoustic Protected Species Observers (APSO), and Passive Acoustic Monitoring (PAM) operators will have met NMFS and BOEM training and experience requirements. PSOs and APSOs will be employed by a third-party observer provider. Briefings between construction supervisors and crews and the PSO/APSO team will be held prior to the start of all pile driving activities as well as when new personnel join the vessel(s). The PSO team and the APSO team will each have a lead observer (Lead PSO and Lead APSO) who will be unconditionally approved by NMFS and have a minimum of 90 days at-sea experience in a northwestern Atlantic Ocean environment performing the visual (Lead PSO) or acoustic role (Lead APSO), with the conclusion of the most recent relevant experience no more than 18 months previous. APSOs responsible for determining if an acoustic detection originated from a NARW will be trained in identification of mysticete vocalizations. PSOs will have no other responsibilities while on watch. Lead PSOs carry the same duties as PSOs and also manage the activities associated with the PSO team, PAM team, and SFV team. Any PSO or APSO on duty will have the authority to delay the start of operations or to call for a shutdown based on their observations or acoustic detection. Lead APSOs will be able to troubleshoot the acoustic equipment and assist in making final decisions regarding species identifications, localization, and other acoustic monitoring details that will be relayed to the Lead PSO. A clear line and method of communication between the PSOs/APSOs and pile driving crew will be established and maintained to ensure mitigation measures are conveyed without delay.	C	Increase effectiveness of monitoring with comprehensive training
Applies to All Project Activities	Visual Monitoring	Measures described fully in the SouthCoast Wind Incidental Take Regulations (ITR) Application, March 2024 (LGL 2024) include visual monitoring procedures, equipment, and break periods. Includes specifics on observations during project activities as well as monitoring at night or in low visibility conditions. SouthCoast Wind is exploring opportunities in coordination with NOAA, to use currently available technologies to conduct monitoring using PSOs and APSOs who may be stationed in locations other than offshore vessels (e.g., onshore); however, this does not exempt onsite PSO requirements for each platform (e.g., PSOs onboard the pile driving vessel, detonation vessel, or HRG survey vessel) The following types of equipment will be used to monitor for marine mammals from one or more locations: • Reticle binoculars • Mounted thermal/IR camera system. The camera systems may be automated with detection alerts that will be checked by a PSO on duty; however, cameras may not be manned by a dedicated observer. • Mounted “big-eye” binocular • Hand-held or wearable NVDs • IR spotlights • Data collection software system • PSO-dedicated VHF radios • Digital single-lens reflex camera equipped with 11.8 inch (300 millimeter) lens.	C	Increase effectiveness of monitoring by using the best available equipment and procedures
Applies to All Project Activities	Visual Monitoring During Vessel Transit	Measures specify that PSOs and/or trained vessel crew will observe for marine mammals at all times when vessels are transiting to/from and within the Project area and port, and that PSOs and/or vessel crew will request vessel-strike avoidance measures if necessary.	C	Increase effectiveness of monitoring to minimize impacts during vessel transit
Applies to All Project Activities	Vessel Strike Avoidance – Observers and Separation Distances	All vessels, including those transiting to and from local ports and the Project area, will follow the vessel strike avoidance measures outlined in SouthCoast Wind’s ITR, except in cases where following these requirements would put the safety of the vessel or crew at risk. General measures include training requirements, the presence of a dedicated observed (NMFS-approved PSO or trained crew member) with no concurrent duties on board all vessels when transiting, and details on monitoring the NMFS NARW reporting systems (Right Whale Sighting Advisory Systems [RWSAS], WhaleAlert, and VHF Channel 16). Measures specific separation distances that vessels will maintain from marine mammals as follows: • Maintaining >500 m distance from any sighted NARW or an unidentified large marine mammal. • Maintaining >100 m from sperm whales and all other baleen whales, • Maintaining >50 m from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction. Measures described fully in SouthCoast Wind’s ITR include the actions to be taken (i.e., changes to vessel course and speed) if a marine mammal is observed within the separation distances.	C	Establish operational standards to minimize risk to marine mammals

Application	Measure	Description	Project Phase	Expected Effects
Applies to All Project Activities	Vessel Strike Avoidance – Speed Reduction	Measures state that vessels will comply with mandatory measures stipulated in the NOAA NARW Vessel Strike Reduction Regulations. All vessels, regardless of size, will transit at ≤10 kts within any active NARW SMAs and Slow Zone (i.e., DMAs or acoustically-triggered Slow Zones). During migratory and calving periods from November 1 to April 30, all project vessels will operate at ≤10 knots when in the Project Area. All vessel speeds will be reduced to ≤10 kts when mother/calf pairs, pods, or large assemblages of marine mammals are observed. SouthCoast Wind will implement (or participate in a joint program, if developed) a PAM system designed to detect NARW within the transit corridor and additional visual monitoring measures as described fully in SouthCoast Wind's ITR. A Vessel Strike Avoidance Plan that provides a more detailed description of the equipment and methods to conduct the monitoring summarized below will be provided to NMFS at least 90-days prior to commencement of vessel movements associated with the activities covered by the ITR. **Acoustic Monitoring:** • A PAM system consisting of near real-time bottom mounted and/or mobile acoustic monitoring systems will be installed such that NARW and other large whale calls made in or near the corridor can be detected and transmitted to the transiting vessel (either directly or through an operations base). • The detections will be used to determine areas along the transit corridor where vessels would be allowed to travel at >10 knots when no other speed restrictions are in place (e.g., 10-knot speed restriction in SMAs and DMAs). • Any detection of a large whale (including NARW) via the PAM system within the transit corridor will trigger a ≤10-knot speed restriction for all Project vessels until the whale can be confirmed visually beyond 500 m of the vessel or 24 hours following the detection and any re-detection has passed. • If the PAM system temporarily stops working, all vessels, regardless of size, will transit at <10 knots in all SMAs (applicable November 1 to April 30) and DMAs (any time of year). Between May 1 and October 31, all vessels regardless of size, will transit at > 10 knots and implement visual monitoring measures with dedicated observers as described above.	C	Establish operational standards to minimize risk to marine mammals
Applies to All Project Activities	Data Recording	Measures specify that all data will be recorded based on standard PSO collection requirements using industry-standard software. Data recorded will include information related to ongoing operations, observation methods and effort, visibility conditions, marine mammal detections, and any mitigation actions requested and enacted.	C	Increase effectiveness of monitoring to avoid or minimize impacts on marine mammals from underwater noise-producing activities
Applies to All Project Activities	Reporting Protocols	Measures define specific marine mammal observations and situations (e.g., observations of dead, stranded, entangled, or injured animals) that would require reporting to NMFS. Measures specify protocols for submission of data and final reports to NMFS and BOEM.	C	Increase operational awareness and monitoring effectiveness to minimize risks to marine mammals
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Pile Driving – Visual Monitoring	Measures detail required monitoring equipment and visual monitoring protocols that will occur from each monitoring vessel as summarized below. Measures intend to provide complete visual coverage of the clearance zone during the pre-start clearance period prior to pile driving and the shutdown zones during impact and vibratory pile driving. Measures specify that impact and vibratory pile driving may be initiated after dark or during daytime reduced visibility periods following protocols described fully in SouthCoast Wind's ITR. Measures state that SouthCoast will prepare a more detailed description of the anticipated efficacy of the technologies it intends to use during nighttime monitoring and describe how they will be used to monitor the pre-start clearance and shutdown zones. This will be provided to NMFS after publication of the draft ITRs so that it can be considered during preparation of the Final ITRs. **Daytime Visual Monitoring:** Visual monitoring will occur from the construction vessel and two dedicated PSO vessels. Daytime visual monitoring is defined by the period between nautical twilight rise and set for the region. Visual monitoring measures below intend to provide complete visual coverage of the pre-start clearance zone during the pre-start clearance period prior to pile driving and the shutdown zones during impact and vibratory pile driving. The following visual monitoring protocols include: • Three PSOs on duty will keep watch from each platform (the pile driving vessel and two PSO vessels), during the pre-start clearance period, throughout pile driving, and 30 minutes after piling is completed. • During pile driving activities, at least three PSO will be on duty on each platform during all other daylight periods. • PSOs will monitor for at least 60 minutes before, during, and 30 minutes after each piling event • One PSO will monitor areas closer to the pile being installed for smaller marine mammals using the naked eye, reticle binoculars and/or other electronic method(s) while two PSOs periodically scans farther from the pile using the mounted big eye binoculars and/or other electronic method(s). • PSO will monitor the NMFS NARW reporting systems including WhaleAlert and SAS once every 4-hour shift during Project related activities. **Daytime Periods of Reduced Visibility:** These measures will apply during the pre-start clearance period, during active pile driving, and 30 minutes after piling is completed.	C	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals from underwater noise-producing activities

Application	Measure	Description	Project Phase	Expected Effects
		• If the Level B harassment zone is obscured, the three PSOs on watch will continue to monitor the shutdown zone utilizing thermal camera systems and/or other electronic method(s) and PAM. • During nighttime or low visibility conditions, the three PSOs on watch will monitor the shutdown zone with the mounted IR camera (further described in under "Nighttime Visual Monitoring"), available handheld night vision, and/or other electronic method(s). • All on-duty PSOs will be in contact with the APSOs who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area (impact pile driving only). **Nighttime Visual Monitoring** During nighttime operations, night vision equipment (night vision goggles) and infrared/thermal imaging technology will be used. The following nighttime piling monitoring and mitigation methods use the best currently available technology to mitigate potential impacts and result in the least practicable adverse impact. • During nighttime operations, visual PSOs on-watch will work in three person teams observing with NVDs and/or monitoring IR thermal imaging camera system. There will also be an APSO on duty conducting acoustic monitoring in coordination with the visual PSOs. • The PSOs on duty will monitor for marine mammals and other protected species using night-vision devices with thermal clip-ons, a hand-held spotlight (one set plus a backup set), and/or other electronic methods, such that PSOs can focus observations in any direction. • If possible, deck lights will be extinguished or dimmed during night observations when using the NVDs (strong lights compromise the NVD detection abilities); alternatively, if the deck lights must remain on for safety reasons, the PSO will attempt to use the NVDs in areas away from potential interference by these lights.		
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Pile Driving – Acoustic Monitoring	Since visual observations within the applicable shutdown zones can become impaired at night or during daylight hours due to fog, rain, or high sea states, visual monitoring with thermal and NVDs will be supplemented by PAM during these periods. Acoustic monitoring and mitigation measures described fully in Section 11.1.4 of SouthCoast Wind's ITR will be followed during WTG and OSP foundation installation requiring pile driving only. • At least one APSO will be on watch during all pre-clearance periods and active pile driving (daylight, reduced visibility, and nighttime monitoring). • There will be one APSO on duty who will begin monitoring at least 60 minutes prior to initiation of pile driving, continue throughout piling, and extend at least 30 minutes post-installation during both daytime and nighttime/low visibility conditions. • The PAM operator will view all PAM data streams split across two monitors while using PAMGuard (or similar) for all data visualizations. In order to ensure calls are correctly classified, SouthCoast Wind will delay/shutdown piling immediately following the detection of a potential large whale on any of the PAM data streams. Piling will not begin until the animal is no longer visible across any of the data streams for at least 30 minutes. During the pause in piling, the PAM operator will work to identify the species. • APSOs will rotate on a 4-hour basis when monitoring from a 24-hour operation vessel or base of operations • A real-time PAM system will be used to supplement visual monitoring during all pre-start clearance, piling, and post-piling monitoring periods. • All on-duty PSOs will be in contact with the APSO on duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area. • For real-time PAM systems, at least one APSO will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore. • The PAM operator will inform the PSOs on duty of animal detections approaching or within the applicable mitigation zones via the data collection software system (i.e., Mystcetus or similar system) or other direct forms of communication (radio, phone, messaging app). The PSO will then be responsible for requesting that any necessary mitigation procedures are implemented. • The PAM system will have the capability of monitoring up to 10 km from the pile. • The PAM system will not be located on the pile installation vessel to reduce masking of marine mammal sounds. • A PAM Plan will be submitted to NMFS and BOEM prior to the planned start of pile driving	C	Increase detection of marine mammals and increase the area capable to be effectively monitored to avoid or minimize exposure of marine mammals to pile driving noise that may cause harassment or PTS.
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Pile Driving – Pre-Start Clearance	A pre-start clearance period will be implemented for all foundation installation occurring both inside and outside the 20-kilometer area of concern. For foundations installed within the 20-km area of concern (June 1 through October 15), a minimum visibility zone of 4,900 m for pin pile and 7,500 meters for monopile installation will be implemented. For OSP foundations (and WTG jacket foundations, if installed) installed throughout the rest of the Lease Area (outside the area of concern), a minimum visibility zone of 2,600 m for pin pile and 3,700 meters for monopile and pin pile installation will be implemented. For impact pile driving, PAM will begin 60-minutes prior to the start of pile driving. Pre-start clearance zones will follow the same zone sizes as outlined under "Pile Driving – Shutdown Zones". • Visual monitoring will begin at least 60 minutes prior to the start of impact pile driving and 30 minutes prior to the start of vibratory pile driving.	C	Minimize impacts to marine mammals from underwater noise-producing activities by ensuring the area is clear

Application	Measure	Description	Project Phase	Expected Effects
		• To begin the clearance process, PSOs will visually clear (i.e., confirm no observation of marine mammals) the relevant minimum visibility zone for 30 minutes immediately prior to commencing foundation installation activities. If PSOs cannot visually monitor the relevant minimum visibility zone prior to the start of pile driving, pile driving operations will not commence. • Once the clearance process has begun, visual monitoring will be conducted (including the use of IR and NVD systems, as appropriate) and PAM for at least 60 minutes prior to a soft-start.. • If a marine mammal is observed entering or within the relevant clearance zones, pile driving activity will be delayed. • An acoustic detection localized to a position within the relevant clearance zone(s) will trigger a delay. • Impact and/or vibratory pile driving may commence when either the marine mammal(s) has voluntarily left the specific clearance zone and had been visually or acoustically confirmed beyond that clearance zone, or, when the additional time period has elapsed with no further sighting or acoustic detection (i.e., 15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes for sperm whales and baleen whales [including NARWs]). In cases where these criteria cannot be met, pile driving may restart only if necessary to maintain pile stability at which time SouthCoast Wind will use the lowest hammer energy practicable to maintain stability.		
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Pile Driving – Soft Start	Soft start procedures will be followed, at the beginning of each pile driving event or any time pile driving has stopped for longer than 30 minutes. A soft start procedure will not begin until the relevant clearance zone has been cleared by the visual PSO or APSOs. If a marine mammal is detected within or about to enter the relevant clearance zone, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been observed exiting the relevant clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm whales and baleen whales [including NARWs]).	C	Avoid or minimize impacts on marine mammals and sea turtles from underwater noise-producing activities by using a soft start to allow animals to vacate the area before pile driving begins
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Pile Driving – Shutdowns	If conditions change such that PSOs cannot monitor the relevant shutdown zone following the commencement of pile driving, the PSO will request an immediate shutdown. If a marine mammal is detected entering or within the respective shutdown zone after pile driving has commenced, an immediate shutdown of pile driving will be requested unless the Chief Engineer or Vessel Captain determine shutdown is not feasible. If a shutdown is not feasible at that time in the installation process due to a risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk of injury or loss of life for individuals, or the risk of jeopardizing the installation process (pile refusal or instability), a reduction in the hammer energy of the greatest extent possible will be implemented. The shutdown zone will be continually monitored by PSOs and APSOs during any pauses in pile driving. If a marine mammal is sighted within the shutdown zone during a pause in piling, resumption of pile driving will be delayed until the animal(s) has exited the relevant shutdown zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm whales and baleen whales [including NARWs]). Following shutdown, pile driving will restart using the same procedure described above.	C	Avoid or minimize impacts on marine mammals or sea turtles from underwater noise-producing activities by halting activities when animals enter an unsafe area

<table>
<tr><th>Application</th><th>Measure</th><th>Description</th><th>Project Phase</th><th>Expected Effects</th></tr>
<tr><td>Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations</td><td>Pile Driving – Shutdown Zones</td><td>The ranges of shutdown zones in the table below are based upon the Level A exposure ranges with 10 dB of noise attenuation for foundation installation across Year 1 and Year 2. If the shutdown zone is equivalent to the “NAS perimeter”, this means the outside perimeter of the NAS. Therefore, any animals occurring within the NAS would trigger a shutdown. The NARW shutdown zones (outlined below) are based on the requirement that a visual or acoustic observation of a NARW at any distance will result in immediate shutdown measures. Foundation installations include 9/16 m (tapered) diameter WTG monopiles and 4.5 m WTG and OSP jacket pin piles installed using impact pile driving only during Year 1. During Year 2, foundations may be installed using only impact pile driving or may use a combination of vibratory and impact pile driving. The shutdown zones are the largest zone sizes expected to result from foundation installations for each installation schedule, except in cases where a single species (e.g., fin whales) had a much larger modeled exposure range than other large cetaceans and the next largest zone size was selected. If smaller diameter piles, lower maximum hammer energies and/or total strikes per pile, or more effective NAS are decided upon and used during the construction activities, modeled Level A exposure ranges applicable to those revised parameters would be used, likely resulting in shorter shutdown distances than those shown below based on current maximum pile size and hammer energy assumptions. Further details of installation scenarios and cetacean frequency classifications can be found in SouthCoast Wind’s ITR.
Shutdown Zones (meters) for Pile Driving under different installation scenarios
<table>
<tr><th rowspan="2">Hearing Group</th><th colspan="2">Impact Pile Driving</th><th colspan="4">Combined Impact and Vibratory Pile Driving (Year 2 only)</th><th>Concurrent Impact Pile Driving (1 monopile and 4 OSP jacket pin piles)</th><th>Concurrent Impact Pile Driving (4 WTG jacket pin piles and 4 OSP jacket pin piles)</th></tr>
<tr><th>WTG Monopile</th><th>WTG Jacket</th><th>WTG Monopile (impact)</th><th>WTG Monopile (vibratory)</th><th>WTG Jacket (impact)</th><th>WTG Jacket (vibratory)</th><th>WTG Monopile</th><th>WTG Jacket</th></tr>
<tr><td colspan="9">Summer</td></tr>
<tr><td>LFC</td><td>3,500</td><td>2,000</td><td>3,500</td><td>200</td><td>1,900</td><td>NAS perimeter</td><td>3,500</td><td>2,600</td></tr>
<tr><td>NARW</td><td colspan="8">any distance</td></tr>
<tr><td>MFC</td><td colspan="8">NAS perimeter</td></tr>
<tr><td>HFC</td><td colspan="8">NAS perimeter</td></tr>
<tr><td>Seals</td><td>200</td><td>NAS perimeter</td><td>200</td><td>NAS perimeter</td><td>NAS perimeter</td><td>NAS perimeter</td><td>300</td><td>200</td></tr>
<tr><td colspan="9">Winter</td></tr>
<tr><td>LFC</td><td>3,700</td><td>2,300</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>NARW</td><td>any distance</td><td>any distance</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>MFC</td><td>NAS perimeter</td><td>NAS perimeter</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>HFC</td><td>NAS perimeter</td><td>NAS perimeter</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Seals</td><td>200</td><td>400</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>
*N/A – not applicable; combined impact and vibratory foundation installation would only occur in the summer of Year 2</td><td>C</td><td>Establish safety measures to avoid or minimize impacts on marine mammals from underwater noise-producing activities</td></tr>
<tr><td>Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations</td><td>Pile Driving – Post Piling Monitoring</td><td>PSOs will continue to survey the shutdown zone throughout the duration of pile installation and for a minimum of 30 minutes after piling has been completed.</td><td>C</td><td>Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals from underwater noise-producing activities</td></tr>
<tr><td>Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations</td><td>Pile Driving – Noise Attenuation</td><td>Several recent studies summarizing the effectiveness of noise attenuation systems (NAS) have shown that broadband sound levels are likely to be reduced by anywhere from 7 to 17 dB, depending on the environment, pile size, and the size, configuration and number of systems used, such as single bubble curtain, large bubble curtains with two rings, double bubble curtains, etc. Combinations of systems (e.g., double big bubble curtain, hydrosound damper plus single big bubble curtain) potentially achieve much higher attenuation. The type and number of NAS to be used during construction have not yet been determined. Based on prior measurements a combination of NAS is reasonably expected to achieve far greater than 10 dB broadband attenuation of impact pile driving sounds.</td><td>C</td><td>Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals from underwater noise-producing activities by dampening sound</td></tr>
<tr><td>Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations</td><td>Pile Driving – Sound Source Verification</td><td>A detailed plan for Sound Source Verification (SSV) will be developed and submitted to NMFS prior to planned start of pile driving. Measurements of each pile type (monopiles and/or piled jackets), on at least the first three piled foundations to be installed, will be conducted to determine the sound levels produced and effectiveness of the NAS(s). Procedures for how measurement results will be used to justify any requested changes to planned monitoring and mitigation distances.</td><td>C</td><td>Adaptive monitoring and reporting to verify the appropriateness of clearance and shutdown zones. These zones may be adjusted as needed based on these reported measurements.</td></tr>
</table>

Application	Measure	Description	Project Phase	Expected Effects
		The plan will require measurement of the sound levels produced by each pile type at 750 meters and other various distances and azimuths relative to the pile location designed to gather data on sounds produced during installation scenarios specific to the Project. These measurements will be used to validate the modeled sound levels at 750 and other distances as provided in Appendix G1 of Appendix A of SouthCoast Wind's ITR. These measurements are designed to assess whether or not the distances to the Level A and Level B harassment isopleths and/or other mitigation action distances align with the distances modelled. The plan should include procedures for determining how measurements will be used to justify any changes to planned monitoring and mitigation distances. SSV will include at least one recorder in each of the four azimuths around the pile (to capture potential directivity of the sound field). Additionally, there will be 3-4 recorders along one azimuth to capture the propagation loss in at least one direction to allow assessment of the modelled Level A harassment and Level B harassment isopleths.		
Applies to Impact and Vibratory Pile Driving during Installation of WTG and OSP Foundations	Potential Additional Measures to Protect NARWs	Potential additional measures state that the period from January through April is when the highest number of NARW are present in the region, and to reduce the need for foundation installations during this period and associated impacts to the NARW, SouthCoast Wind may conduct nighttime pile driving of monopile or piled jacket foundations during time periods when the fewest number of NARW are likely to be present in the region. These measures will be finalized through continued negotiations between NOAA and SouthCoast Wind. Specific measures as they currently stand include: Concentrating construction activities when NARW are less likely to be present within the region (May 15 through December 31), including in the Lease Area. Specific monitoring tools and plans will be developed as a part of the ongoing ITR Application process, but may include the use of advanced infrared systems, near real-time PAM, autonomous underwater vehicles, autonomous aerial vehicles, or other advanced technologies that could improve the probability of detecting marine mammals at night. As a result of concerns related to potential NARW use of the Nantucket Shoals region outside of the January−April seasonal restriction period, additional mitigation and monitoring measures have been proposed in a NARW mitigation and monitoring plan for pile driving to further minimize the potential for impacts. These measures also include the commitment to only use impact pile driving in specified areas of the Lease Area (Project 1) and intends to monitor and mitigate for NARW within the Level B harassment zones for impact pile driving (in addition to the requirement that a visual or acoustic observation of NARW at any distance will result in immediate shutdown zone measures [see Pile Driving – Shutdown Zones]). These measures also include a commitment that no pile driving for foundation installations will occur from January 1 through May 14 each year. On top of the seasonal description described, no pile driving for WTG or OSP foundation installations will occur within the 20-km area of concern during the month of May or after October 15. Additional mitigation and monitoring measures include: **Vessel-Based Visual Monitoring:** A total of three monitoring vessels will conduct visual monitoring for NARW and other marine mammals, with three PSOs on duty on each monitoring vessel during pre-start clearance and pile driving periods. In addition, when pile driving occurs inside the NMFS 20-km Area of Concern during August - October 15 and anywhere in the Lease Area between May 15 - 31 and in December, SouthCoast Wind will add one additional dedicated vessel, for a total of four monitoring vessels. **Acoustic Monitoring:** Acoustically monitor a larger distance than the Level B harassment zones by deploying a PAM array to cover a 15-km zone for monopile installation and a 10-km zone for pin pile installation. NARW calls localized within the relevant PAM monitoring zone will result in a delayed start or shutdown of pile driving. Refer to the *North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving,* submitted separately, for additional details.	C	Avoid or minimize impacts on NARWs from Project activities
Applies to HRG Surveys during Construction and O&M Phases	HRG Surveys - Visual Monitoring	Measures for HRG surveys apply only to sound sources with operating frequencies below 180 kHz. There are no mitigation or monitoring protocols required for sources operating >180 kHz. HRG surveys can occur either during daylight hours only or 24-hours per day. Measures specify the requirements for equipment and PSO visual monitoring protocols during daylight, low visibility, and nighttime conditions as summarized below: • Four PSOs on board any 24-hour survey vessels. • Two PSOs on board any daylight survey vessels. • One PSO on watch during all daylight surveying. • Two PSOs on watch during nighttime surveying. • PSOs will begin observation of the shutdown zones prior to initiation of HRG survey operations and will continue throughout the survey activity and/or while equipment operation below 180 kHz is in use. • PSO will monitor the NMFS NARW reporting systems including WhaleAlert and SAS once every 4-hour shift during Project related activities.	C, O&M	Increase effectiveness of mitigations to minimize impacts of HRG surveys

Application	Measure	Description	Project Phase	Expected Effects
		Daytime Visual Monitoring One PSO on watch during pre-start clearance periods and all source operations. PSOs will use reticle binoculars and the naked eye to scan the shutdown zone for marine mammals **Nighttime and Low Visibility Monitoring** The Lead PSO will determine if conditions warrant implementing reduced visibility protocols. Two PSOs on watch during pre-start clearance periods, all operations, and for 30 minutes following use of HRG sources operating below 180 kHz. Each PSO will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons and a hand-held spotlight (one set plus a back-up set), such that PSOs can focus observations in any direction.		
Applies to HRG Surveys during Construction and O&M Phases	HRG Surveys – Shutdown Zones	PSOs will establish and monitor marine mammal shutdown zones. Distances to shutdown zones will be from any acoustic sources, not the distance from the vessel. Shutdown zones will be as follows: • 500 m from NARW for use of impulsive acoustic sources (e.g., boomers and/or sparkers) and non-impulsive nonparametric sub-bottom profilers • 100 m from all other marine mammals for use of impulsive acoustic sources (e.g., boomers and/or sparkers), except for delphinids when approaching the vessel or towed acoustic sources, shutdown is not required	C, O&M	Establish safety measures to avoid or minimize impacts on marine mammals from underwater noise-producing activities
Applies to HRG Surveys during Construction and O&M Phases	HRG Surveys – Pre-start Clearance	PSOs will establish and monitor pre-start clearance zones. Distances to pre-start clearance zones for HRG surveys will be the same as those for shutdown zones described above. • PSOs will conduct 30 minutes of pre-start clearance observation prior to the initiation of HRG operations. • The pre-start clearance zones must be visible using the naked eye or appropriate technology during the entire pre-start clearance period for operations to start. If the pre-start clearance zones are not visible, source operations <180 kHz will not commence • Ramp-up may not be initiated if any marine mammal(s) is detected within its respective pre-start clearance zone. • If a marine mammal is observed entering or within the pre-start clearance zones during the pre-start clearance period, relevant acoustic sources must not be initiated until the marine mammal(s) is confirmed by visual observation to have exited the relevant zone, or, until an additional time period has elapsed with no further sighting of the animal (15 minutes for odontocetes [excluding sperm whales] and pinnipeds and 30 minutes for sperm and baleen whales [including NARWs]).	C,O&M	Avoid impacts of underwater noise from HRG surveys to marine mammals by ensuring that the area is clear prior to the start of the HRG survey
Applies to HRG Surveys during Construction and O&M Phases	HRG Surveys – Ramp-Up	The ramp-up procedure will not be initiated during periods of inclement conditions or if the pre-start clearance zones cannot be adequately monitored by the PSOs, using the appropriate visual technology for a 30-minute period immediately prior to ramp-up. Ramp-up will begin with the power of the smallest acoustic equipment at its lowest practical power output. When technically feasible, the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually. Ramp-up activities will be delayed if marine mammal(s) enters its respective shutdown zone. Ramp-up will continue if the animal(s) has been observed exiting its respective shutdown zone, or until an additional time period has elapsed with no further sighting of the animal (15 minutes for odontocetes [excluding sperm whales] and 30 minutes for sperm and baleen whales [including NARWs]).	C, O&M	Avoid or minimize impacts of underwater noise from HRG surveys to marine mammals by using a ramp-up start to allow animals to vacate the area
Applies to HRG Surveys during Construction and O&M Phases	HRG Surveys – Shutdowns	Immediate shutdown of impulsive, non-parametric HRG survey equipment other than CHRIP sub-bottom profilers operating at frequencies <180 kHz is required if a marine mammal is observed within or entering the relevant shutdown zone. Any PSO on duty has the authority to call for shutdown of acoustic sources. When there is certainty regarding the need for mitigation action on the basis of visual detection, the relevant PSOs must call for such action immediately. Upon implementation of a shutdown, survey equipment may be reactivated when all marine mammals that triggered the shutdown have been confirmed by visual observation to have exited the relevant shutdown zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes sperm whales and other baleen whales [including NARWs]). If the acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, the acoustic sources may be reactivated as soon as is practicable at full operational level if PSOs have maintained constant visual observation during the shutdown and no visual detections of marine mammals occurred within the applicable shutdown zone during that time. If the acoustic source is shut down for a period longer than 30 minutes or PSOs were unable to maintain constant observation, then ramp-up and pre-start clearance procedures will be initiated. If delphinids are visually detected approaching the vessel or towed acoustic sources, shutdown is not required.	C, O&M	Avoid or minimize impacts of underwater noise from HRG surveys to marine mammals by halting noise production once animals enter an unsafe area
Applies to UXO Detonation	UXO Detonation – General Measures and Seasonal Restriction	For UXOs that are positively identified in proximity to planned activities on the seabed, several alternative strategies will be considered prior to detonating the UXO in place. These may include relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce	C	Increase effectiveness of mitigations to minimize impacts of underwater noise

<table>
<tr><th>Application</th><th>Measure</th><th>Description</th><th>Project Phase</th><th>Expected Effects</th></tr>
<tr><td></td><td></td><td>the net explosive yield of a UXO (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would a decision to detonate the UXO in place be made. If deflagration is conducted, mitigation and a monitoring measure would be implemented as if it was a high order detonation based on UXO size. Decision on removal method will be made in consultation with a UXO specialist and in coordination with the agencies with regulatory oversite of UXO. For detonations that cannot be avoided due to safety considerations, a number of mitigation measures will be employed by SouthCoast Wind, as described in the ITR (LGL 2024).
No more than a single UXO will be detonated in a 24- hour period, and there are no UXO detonations planned between January and April</td><td></td><td>from UXO detonations on marine mammals</td></tr>
<tr><td>Applies to UXO Detonation</td><td>UXO Detonation – Pre-start Clearance and Post-Detonation Monitoring</td><td>All mitigation and monitoring zones assume the use of a NAS resulting in a 10 dB reduction of noise levels. Mitigation and monitoring zones specific to marine mammal hearing groups for the five different charge weight bins are available in the ITR
A 60-minute pre-start clearance period will be implemented prior to any UXO detonation
The pre-start clearance zones in the table below must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the pre-start clearance zone for at least 30 minutes prior to commencing detonation
The pre-start clearance zone size will be dependent on the charge weight of the identified UXO, which will be determined prior to detonation. If the charge weight is determined to be unknown or uncertain, the largest pre-start clearance zone size (charge weight bin E12) will be used throughout the pre-start clearance period.
All marine mammals must be confirmed to be out of the pre-start clearance zone prior to initiating detonation
If a marine mammal is observed entering or within the relevant pre-start clearance zones prior to the initiation of detonation, the detonation must be delayed
The detonation may commence when either the marine mammal(s) has voluntarily left the respective pre-start clearance zone and have been visually confirmed beyond that pre-start clearance zone, or after 15 minutes for odontocetes [excluding sperm whales] and pinnipeds, and 30 minutes for sperm and baleen whales [including NARWs] with no further sightings.
Post-detonation monitoring will occur for 30 minutes.
Mitigation and Monitoring Zones associated with in-situ UXO detonation of the largest charge weight (E12), with 10 dB NAS
<table>
<tr><th>Hearing Group</th><th>Pre-start Clearance Zone (m)</th><th>Level B Harassment Zone (m)</th><th>PAM Monitoring Zone (km)</th></tr>
<tr><td colspan="4">Lease Area</td></tr>
<tr><td>LFC</td><td>4,300</td><td>11,900</td><td>15</td></tr>
<tr><td>MFC</td><td>400</td><td>2,600</td><td>15</td></tr>
<tr><td>HFC</td><td>8,700</td><td>14,100</td><td>15</td></tr>
<tr><td>PPW</td><td>1,600</td><td>7,000</td><td>15</td></tr>
<tr><td colspan="4">Export Cable Corridor</td></tr>
<tr><td>LFC</td><td>4,900</td><td>11,800</td><td>15</td></tr>
<tr><td>MFC</td><td>600</td><td>2,500</td><td>15</td></tr>
<tr><td>HFC</td><td>7,400</td><td>13,700</td><td>15</td></tr>
<tr><td>PPW</td><td>2,600</td><td>7,100</td><td>15</td></tr>
</table>
* Pre-start clearance zones were calculated by selecting the largest Level A threshold (the larger of either the PK or SEL noise metric). The chosen values were the most conservative per charge weight bin across each of the four modeled sites. Please refer to SouthCoast Wind’s ITR (LGL) for monitoring zones for charge weights E4 (2.3 kg) to E10 (2.27 kg)</td><td>C</td><td>Ensure the area is clear prior to the start of UXO detonation and that UXO detonation was performed safely</td></tr>
<tr><td>Applies to UXO Detonation</td><td>UXO Detonation – Visual Monitoring</td><td>Measures as described in SouthCoast Wind’s ITR (LGL 2024) specify the requirements for equipment and protocols for PSO visual monitoring during UXO detonation. The number of vessels deployed will depend on the pre-start clearance zone size shown in the table above and safety set back distance from the detonation. A sufficient number of vessels will be deployed to cover the clearance and shutdown zones.
PSOs will visually monitor the Low Frequency Cetacean pre-start clearance zone depending on the identified charge weight. This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with High Frequency cetaceans
<u>Detonation Vessel Measures</u>
Three PSOs on duty on the detonation vessel
Three PSOs will maintain watch at all times during the pre-start clearance period and 30 minutes after the detonation event. Each PSO will be responsible for monitoring a 120-degree sector with the unaided eye and reticle binoculars to provide additional coverage beyond the pre-start clearance zone away from the detonation location.
The three visual PSOs onboard the detonation vessel will monitor out to the relevant pre-start clearance zone (as outlined in the table above) at least 30 minutes prior to a detonation event; there will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods</td><td>C</td><td>Increase effectiveness of monitoring to minimize impacts of UXO detonations</td></tr>
</table>

Application	Measure	Description	Project Phase	Expected Effects
		Additional PSO Vessel Measures Based on the relevant pre-start clearance zones (determined by the identified charge weight) for low-frequency cetaceans shown in the table above, an additional PSO vessel will be used for UXO charge weight bins E10 and E12. The additional PSO vessel will circle the detonation vessel at or near the relevant pre-start clearance zone distance (4 – 5 km for charge weight bins E10 – E12). The additional PSO vessel will circumnavigate the detonation vessel at 7 – 10 knots during the pre-start clearance period, throughout the detonation event (as allowed by safety consideration), and during post-detonation monitoring. Visual monitoring will be conducted on the additional PSO vessel following the same methods as stated for the detonation vessel. Additionally, the three PSOs on duty will be responsible for monitoring a 120-degree sector with the unaided eye and reticle binoculars to provide additional coverage inside the relevant pre-start clearance zone towards the detonation vessel as well as beyond the pre-start clearance zone away from the detonation location.		
Applies to UXO Detonation	UXO Detonation – Acoustic Monitoring	There will be one PAM team for all deployed PSO vessels. PAM will be conducted in the daylight only as no UXO will be detonated during nighttime hours. There will be a PAM operator stationed on at least one of the dedicated monitoring vessels (primary or secondary) in addition to the PSO; or located remotely/onshore. PAM will begin 60 minutes prior to a detonation event. PAM operator will be on duty during all pre-start clearance periods and post-detonation monitoring periods. Acoustic monitoring will extend beyond the Low Frequency Cetacean pre-start clearance zone for a given charge weight. For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore. PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the detonation activity via the data collection software system. PAM devices used may include independent (e.g., autonomous or moored remote) systems. The PAM system will have the capability of monitoring up to 15 km from the detonation location.	C	Increase effectiveness of monitoring to minimize impacts of UXO detonations
Applies to UXO Detonation	UXO Detonation – Noise Attenuation	SouthCoast Wind will use NAS for all detonation events as feasible and will strive to achieving the modeled ranges associated with 10 dB of noise attenuation. Zones without 10 dB attenuation would be implemented if use of a big bubble curtain was not feasible due to location, depth, or safety related constraints. If a NAS system is not feasible, SouthCoast Wind will implement mitigation measures for the larger unmitigated zone sizes with deployment of vessels adequate to cover the entire pre-start clearance zones.	C	Increase effectiveness of mitigations to minimize impacts of underwater noise from UXO detonations on marine mammals by dampening noise
Applies to UXO Detonation	UXO Detonation – Sound Source Verification	Measurements will be made for each UXO/MEC that must be that must be detonated using methods as described for pile driving. A sound field verification plan for UXO detonation will be submitted to NMFS 180 days prior to planned start of UXO detonations.	C	Adaptive monitoring and reporting to verify the appropriateness of clearance and shutdown zones. These zones may be adjusted as needed based on these reported measurements.
Applies to Fisheries and Benthic Monitoring Surveys	FMP & BMP – General Measures	All vessels will comply with applicable vessel speed regulations and mitigation measures. All vessel operators and crews supporting FMP and BMP surveys will receive protected species identification training and maintain a vigilant watch for marine mammals and other protected species and will respond with the appropriate action to avoid vessel strikes (e.g., change course, slow down, navigate away from animal, etc.). At least one survey staff on board the trawl survey will have completed the Northeast Fisheries Observer Program (NEFOP), the NMFS-required PSO training within the last five years, or other equivalent training in protected species identification and safe handling. Operators and crew aboard fisheries and benthic survey vessels will be engaged in regular marine mammal watches during daylight hours prior to the deployment of survey gear (e.g., trawls, ventless traps, etc.) and will continue until gear is brought back on board. If marine mammals are observed in the survey area within 15 minutes prior to deployment of research gear and are considered to be at risk of interaction with said gear, the sampling station will be moved, canceled, or suspended until there are no sightings for 15 minutes within 1 nm of the sampling location. SouthCoast Wind does not anticipate and is not requesting take of marine mammals incidental to research trawl surveys but, in the case of a marine mammal interaction, the Marine Mammal Stranding Network will be contacted immediately.	Pre-C, C, O&M	Minimize the risk of marine mammal entanglement and vessel interactions during fisheries and benthic monitoring surveys
Applies to Fisheries and Benthic Monitoring Surveys	FMP & BMP – Vessel Separation Distances	Vessels will maintain the following separation distances from marine mammals: • > 500 m distance from any sighted NARW or an unidentified large marine mammal • > 100 m from sperm whales and non-NARW baleen whales • > 50 m from all delphinid cetaceans and pinnipeds, with the exception of animals approaching the vessel (e.g., bow-riding dolphins), in which case the vessel operator must avoid excessive speed or abrupt changes in direction.	Pre-C, C, O&M	Minimizes the risk of marine mammal vessel interactions during fisheries and benthic monitoring surveys.

Application	Measure	Description	Project Phase	Expected Effects
Applies to Fisheries and Benthic Monitoring Surveys	Gear-specific Mitigation Measures	The following mitigation measures will be used to minimize the potential for marine mammal capture during the research trawling: • All gear restrictions, closures, and other regulations set forth by take reduction plans (e.g., Harbor Porpoise Take Reduction Plan, Atlantic Large Take Whale Reduction Plan, etc.) will be adhered to as with typical scientific fishing operations to reduce the potential for interaction or injury; • Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before, during, and after haul back. When the captain and/or member of the scientific crew are designated as the dedicated PSO, it is their sole responsibility for the duration of the haul; • Trawl operations will commence as soon as possible once the vessel arrives on station; the target tow time will be limited to 20 minutes; • Marine mammal visual observations will be conducted when sampling and during vessel transits to/from sampling stations and will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (i.e., throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, the most appropriate action to avoid interaction will be taken. • Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk or interaction, all gear will be immediately removed; • The codend of the net will be opened close to the deck/sorting area to avoid damage to animals that may be caught in gear. Gear will be emptied as close to the deck/sorting area and as quickly as possible after retrieval; • Trawl nets will be fully cleaned and repaired (if damaged) before setting again.	Pre-C, C, O&M	Minimizes the risk of marine mammal entanglement, prey bycatch, and vessel interaction during fisheries and benthic monitoring surveys.
Applies to Fisheries and Benthic Monitoring Surveys	Ventless Trap Survey Mitigation Measures	Ventless trap surveys will employ the following mitigation measures to minimize the potential for an interaction with protected species associated with vertical lines: • All sampling gear will be hauled at least once every 30 days, and all gear will be removed from the water at the end of each sampling season (November). • All groundlines will be constructed of sinking line. • Fishermen contracted to perform the field work will be encouraged to use knot-free buoy lines. • To reduce potential risk to right whales, buoy/end lines with a breaking strength of < 1,700 lbs. will be used. All buoy lines will use weak links that are chosen from the list of NMFS-approved gear. This may be accomplished by using whole buoy line that has a breaking strength of 1,700 lbs., or buoy line with weak inserts that result in line having an overall breaking strength of 1,700 lbs. • All buoys and traps will be labeled as research gear, and the scientific permit number will be written on the buoy and on a tag attached to every trap. All markings on the buoys and buoy lines will be compliant with the regulations, and all buoy markings will comply with instructions received by staff at NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division. • Any lines or trawls that go missing will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division as soon as possible.	Pre-C, C, O&M	Minimizes the risk of marine mammal entanglement from vertical lines and mooring systems used during fisheries and benthic monitoring surveys.

Source: LGL 2024; SouthCoast Wind 2023.

APSO = Acoustic Protected Species Observer; BMPs = best management practices; BOEM = Bureau of Ocean Energy Management; C =construction; CHRIP = compressed high intensity radar pulse; D = Decommissioning; dB = decibel; DMA = dynamic management area; DP = dynamic positioning; EFH = essential fish habitat; EPA = Environmental Protection Agency; ESA = Endangered Species Act; GARFO = Greater Atlantic Regional Fisheries Office; HDD = horizontal direction drilling; HFC = high-frequency cetaceans; HRG = high resolution geophysical; IR = infrared; ITR = incidental take regulations; Kg = kilogram; kHz = kilohertz; km = kilometer; Kts = knots; LFC = low-frequency cetaceans; MFC = mid-frequency cetaceans; M = meter; MEC = munitions and explosives of concern; mi = miles MMPA = Marine Mammal Protection Act; NARW = North Atlantic right whale; NAS = noise attenuation system; NEFOP = Northeast Fisheries Observer Program; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; NOx = nitrogen oxides; O = operations; O&M = operations and maintenance; OPR = Office of Protected Resources; OSP = offshore substation platform; OSRP = oil spill response plan; PAM = Passive acoustic monitoring; PPW = phocid pinnipeds in-water; PSO = protected species observer; QA/QC = quality assurance quality control; RWSAS = NMFS Right Whale Sighting Advisory System; SAS = sighting advisory system; SEL = sound exposure level; SMA = seasonal management area; SPCC = spill prevention, control, and countermeasure; SSV = sound source verification; SWPP = stormwater pollution prevention plan; USCG = United States Coast Guard; USEPA = United States Environmental Protection Agency; UXO = unexploded ordnance; VHF = Very High Frequency; WTG = wind turbine generator;

Table 3.3-2. Additional proposed mitigation monitoring, and reporting measures – BOEM proposed

No	Measure	Description	Project Phase	Expected Effects
NS-1	HVDC Open-Loop Cooling System Avoidance Area	To minimize potential impacts onto zooplankton from impingement and entrainment in offshore wind HVDC converter station once-through (open-loop) cooling systems, no open-loop cooling systems would be permitted within the enhanced mitigation area (Figure 3.3-1) of the Lease Area. No geographic restrictions on the offshore export cable corridor, nor the installation of an HVAC OSP are included in this mitigation measure.	O&M	Nantucket Shoals supports dense aggregations of zooplankton such as gammarid shrimp and copepods, which in turn, support higher tropic levels of wildlife. While the SouthCoast Wind Project would not overlap with the highest modeled densities of zooplankton in the Nantucket Shoals region, BOEM is proposing a precautionary measure to reduce the magnitude of potential mortality from entrainment of zooplankton in an HVDC open-loop cooling system by excluding them from the enhanced mitigation area, which extends approximately 7 – 9 miles (11.2 – 14.5 kilometers) southwest of the 30-meter isobath. This measure is anticipated to result in less mortality of zooplankton species than compared with project design envelope which could include HVDC OSP locations closer to Nantucket Shoals and thus closer to higher densities of zooplankton.
NS-2	Pile-Driven Foundations Only	Only monopile or piled jacket foundations may be used east of the enhanced mitigation area (Figure 3.3-1), which would minimize the overall structure impact on benthic prey species.	C, O&M	In May 2023, SouthCoast Wind removed GBS foundations entirely from its PDE and removed suction-bucket jackets as a foundation option for the northern portion of the Lease Area associated with Project 1, which would include the enhanced mitigation area. As a result, SouthCoast Wind's Proposed Action only includes monopile and piled jacket foundations in the enhanced mitigation area. At this time, BOEM is retaining this mitigation measure given that an alternative BOEM is considering through the NEPA process evaluates GBS and suction-bucket jacket foundations throughout the entirety of the Lease Area. The foundation footprint, including scour protection, on the seabed would be reduced by a minimum of 8.94 acres (3.62 hectares) per foundation in comparison to if GBS foundations were used. This would mean a total reduction in seabed footprint of at least 206 acres (83 hectares) for the 23 WTGs located in the enhanced mitigation area. Nantucket Shoals is known to support shellfish species important to food supply for birds. To reduce the potential impact on shellfish populations adjacent to Nantucket Shoals, BOEM is proposing this measure to reduce the potential direct mortality, smothering, by the larger foundation footprint of suction-bucket jacket and GBS foundations in this area.
NS-4	Pile-Driving Time of Year Restriction in Enhanced Mitigation Area	Pile driving within the enhanced mitigation area (Figure 3.3-1) will occur only between June 1 to October 31 when NARW presence is at its lowest.	C	The most recent modeled density of NARW indicate higher densities of NARW on Nantucket Shoals in the late fall through spring, with the highest densities in February. The enhanced mitigation area includes all areas where modeled NARW density is greater than or equal to 1 animal. This will further ensure that no NARW are exposed to injurious levels of noise from pile driving activity when combined with other measures such as protected species observers and acoustic attenuation devices.
BA-1	LOA Requirements	The measures required by the final MMPA LOA for Incidental Take Regulations would be incorporated into COP approval and Record of Decision conditions, and BOEM and/or BSEE will monitor compliance with these measures. BOEM will require the applicant comply with all the BOEM 2021 BMPs and with all future BOEM BMP and PDCs that are published and applicable to the activities when not superseded by LOA, COP, or Record of Decision conditions.	C	Incorporates all LOA requirements into COP approval.
BA-2	Geophysical Surveys and ESA Species	The Lessee will implement measures on all vessels towing boomer, sparker, or bubble gun categories of equipment following all the Project Design Criteria and Best Management Practices for Protected Species from the documents "Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection" and "Offshore Wind Site Assessment and Site Characterization Activities Programmatic Consultation". These documents implement the integrated requirements for threatened and endangered species in the	C, O&M, D	Minimize interaction with ESA-listed species during geophysical survey operations and ensures consistency with design criteria and best management practices of programmatic ESA consultation

No	Measure	Description	Project Phase	Expected Effects
		June 29, 2021, programmatic consultation under the ESA (revised November 22, 2021), as well as the June 29, 2021, NMFS Letter of Concurrence (LoC). BOEM-required measures include: • Establishing a Monitoring Zone (500 m in all directions) for ESA-listed species that must be monitored for 30 minutes of pre-clearance observation around all vessels operating boomer, sparkers, or bubble gun equipment. • Establishing a 500 m Shutdown Zone for North Atlantic right whales and unidentified whales, and a 100 m Shutdown Zone for all other ESA-listed whales visible at the surface around each vessel operating boomer, sparker, or bubble gun equipment • Following pre-clearance procedures, if any loggerhead or other unidentified sea turtles is observed within a 100-meter monitoring zone during a survey, sparker operation should be paused by turning off the sparker until the sea turtle is beyond 100 meters of the survey vessel. • A "ramp up" of the boomer, sparker, or bubble gun survey equipment must occur at the start or re-start of geophysical survey activities when technically feasible.		
BA-3	Fisheries and Benthic Habitat Monitoring Surveys	The Lessee must develop monitoring plans and conduct fisheries research and monitoring surveys, including the benthic survey. The Lessee must conduct these surveys for durations of, at a minimum, 1 year during pre-construction, 1 year during construction, and 2 years post-construction. The Lessee must submit an annual report within 90 days of the completion of each survey season to DOI (renewable_reporting@boem.gov) that includes results and analyses as described in the monitoring plans. The Lessee must share data in accordance with their data sharing plan. The Lessee must comply with applicant-proposed measures for Fisheries and Benthic Monitoring Surveys in addition to BOEM-required measures for ESA-listed species as summarized below: **Trap/Pot/Gillnet Gear:** • All sampling gear will be hauled at least once every 30 days, and gear will be removed from the water and stored on land between sampling seasons. • No surface floating buoy lines will be used. • All groundlines will be composed of sinking line. • Buoy lines will use weak links (< 1,700-lb. breaking strength) that are chosen from the list of NMFS-approved gear • Gillnet string will be anchored with a Danforth-style anchor with a minimum holding strength of 22 lbs. • Knot-free buoy lines will be used to the extent practicable. • All gillnet sampling times will be limited to no more than 24 hours to reduce mortality of entangled sea turtles and sturgeon. If weather or other safety concerns prevent retrieval of the gear within 24 hours of it being set, NMFS GARFO, Protected Resources Division (at nmfs.gar.incidental-take@noaa.gov) must be notified, and the gear must be retrieved as soon as it is safe to do so. • All buoys will be labeled as research gear, and the scientific permit number will be written on the buoy. All markings on the buoys and buoy lines will be compliant with the regulations and instructions received from staff at the Office of Protected Resources. Additional gear modification as required at the discretion of GARFO. • All vessels will have at least one survey team member onboard the trawl surveys and ventless trap surveys who has completed Northeast Fisheries Observer Program observer training (or another training in protected species identification and safe handling, inclusive of taking genetic samples from Atlantic sturgeon) within the last 5 years. • Follow documentation, incidental reporting, observation, and disentanglement and resuscitation requirements and protocols. **Avoiding Protected Species Interactions:** • Initiate protected species watches (visual observation) at least 15 minutes prior to sampling by scanning the surrounding waters with the naked eye and range finding binoculars. If protected species are sighted within 1 nm of the station in the 15 minutes before setting the gear, the	Pre-C, C, O&M	Measure the impact of offshore wind development on marine resources by conducting fisheries and benthic monitoring surveys and minimize potential impacts to ESA-listed species during these monitoring surveys

No	Measure	Description	Project Phase	Expected Effects
		vessel will transit to a different section of the sampling area. Trawl or gillnet gear should not be deployed if protected species are sighted near the survey vessel. • Vessels must travel 10 knots or less in any Seasonal Management Area (SMA), Slow Zone/Dynamic Management Area (DMA). All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (SMAs, DMAs, Slow Zones) and daily information regarding North Atlantic right whale sighting locations. Sightings should not be used as the primary or sole means for avoiding right whales, as they only represent locations where right whales were at one point in time.		
BA-4	Protected Species Detection and Vessel Strike Avoidance: Vessel Crew and Visual Observer Training Requirements	The Lessee must provide Project-specific training to all vessel crew members, Visual Observers, and Trained Lookouts on the identification of sea turtles and marine mammals, vessel strike avoidance and reporting protocols, and the associated regulations for avoiding vessel collisions with protected species. Reference materials for identifying sea turtles and marine mammals must be available aboard all Project vessels. Confirmation of the training and understanding of the requirements must be documented on a training course log sheet, and the Lessee must provide the log sheets to DOI upon request. The Lessee must communicate to all crew members its expectation for them to report sightings of sea turtles and marine mammals to the designated vessel contacts. The Lessee must communicate the process for reporting sea turtles and marine mammals (including live, entangled, and dead individuals) to the designated vessel contact and all crew members. The Lessee must post the reporting instructions including communication channels in highly visible locations aboard all Project vessels.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from vessel encounters
BA-5	Protected Species Detection and Vessel Strike Avoidance: Vessel Observer Requirements	The Lessee must ensure that vessel operators and crew members maintain a vigilant watch for marine mammals and sea turtles, and reduce vessel speed, alter the vessel's course, or stop the vessel as necessary to avoid striking marine mammals or sea turtles. All vessels transiting from ports outside the United States will be required to have a trained lookout on board who will start monitoring for the presence of NARWs and other protected species when the vessel enters U.S. waters, during which the trained lookout must monitor a vessel strike avoidance zone around the vessel. The trained lookout must maintain a vigilant watch at all times a vessel is underway, and when technically feasible, be capable of monitoring the 500-meter Vessel Strike Avoidance Zone for ESA-listed species and to maintain minimum separation distances. Alternative monitoring technology (e.g., night vision, thermal cameras) must be available to maintain a vigilant watch at night and in any other low visibility conditions. If a vessel is carrying a trained lookout for the purposes of maintaining watch for NARWs, a trained lookout for sea turtles is not required, provided that the trained lookout maintains watch for marine mammals and sea turtles. If the trained lookout is a vessel crew member, the lookout obligations, as noted above, must be that person's designated role and primary responsibility while the vessel is transiting. Vessel personnel must be provided an Atlantic reference guide to help identify marine mammals and sea turtles that may be encountered. Vessel personnel must also be provided material regarding NARW Seasonal Management Areas (SMAs), Dynamic Management Areas (DMAs), and Slow Zones, sightings information, and reporting. All observations must be recorded per reporting requirements. Outside of active watch duty, members of the monitoring team must check NMFS Right Whale Sighting Advisory System (RWSAS) for the presence of NARWs in the SouthCoast Wind farm and along the routes vessels are transiting. The trained lookout must check https://seaturtlesightings.org before each trip and report any detections of sea turtles in the vicinity of the planned transit to all vessel operators or captains and lookouts on duty that day. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, the Lessee must have a trained lookout posted on all vessel transits during all phases of the Project to observe for sea turtles. For all vessels operating south of the Virginia/North Carolina border, year-round, the Lessee must have a trained lookout posted on all vessel transits during all phases of the Project to observe for sea turtles. The trained lookout will communicate any sightings in real time to the captain to implement required avoidance measures.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from vessel encounters
BA-6	Protected Species Detection and Vessel Strike Avoidance: Communication of	The Lessee must ensure that whenever multiple Project vessels are operating, any visual detections of ESA-listed species (marine mammals and sea turtles) are communicated in near	Pre-C, C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from vessel encounters

No	Measure	Description	Project Phase	Expected Effects
	Threatened and Endangered Species Sightings	real time to a third-party Protected Species Observer (PSO), vessel captains, or both associated with other Project vessels.		
BA-7	Protected Species Detection and Vessel Strike Avoidance: Vessel Speed Requirements	Vessel captain and crew must maintain a vigilant watch for all protected species and slow down, 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 upon the sighting of a single individual. Vessels underway must not divert their course to approach any protected species. During construction, vessels of all sizes will operate port to port at 10 knots or less between November 1 and April 30 and while operating in the Lease Area, along the export cable route, or transit area to and from ports. Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (11.5 mph) or less while operating in any Seasonal Management Area (SMA) or visually- and acoustically-triggered Slow Zones. This requirement does not apply when necessary for the safety of the vessel or crew. Any such events must be reported (see reporting requirements). Otherwise, these speed limits do not apply in areas of Narragansett Bay or Long Island Sound where the presence of NARWs is not expected. The Lessee may only request a waiver from any visually triggered Slow Zone/DMA vessel speed reduction requirements during operations and maintenance, by submitting a vessel strike risk reduction plan that details revised measures and an analysis demonstrating that the measure(s) will provide a level of risk reduction at least equivalent to the vessel speed reduction measure(s) proposed for replacement. The plan included with the request must be provided to NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division and BOEM at least 90 days prior to the date scheduled for the activities for the waiver is requested. The plan must not be implemented unless NMFS and BOEM reach consensus on the appropriateness of the plan. BOEM encourages increased vigilance through voluntary implementation of best management practices to minimize vessel interactions with NARWs, and by voluntarily reducing speeds to 10 knots or less when operating within an acoustically triggered slow zone, and when feasible, avoid Slow Zones.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from vessel encounters
BA-8	Vessel Strike Avoidance of Large Cetaceans	All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance and daily information regarding NARW 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. Information about active SMAs and Slow Zones can be accessed at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales If an ESA-listed whale or large unidentified whale is identified within 1, 640 feet (500 meters) of the forward path of any vessel (90 degrees port to 90 degrees starboard), the vessel operator must immediately implement strike avoidance measures and steer a course away from the whale at 10 knots (18.5 kilometers per hour) or less until the vessel reaches a 1,640-feet (500 meter) separation distance from the whale. Trained lookouts, visual observers, vessel crew, or PSOs must notify the vessel captain of any whale observed or detected within 1,640 feet (500 meters) of the Project vessel. Upon notification, the vessel captain must immediately implement vessel strike avoidance procedures to maintain a separation distance of 1,640 feet (500 meters) or reduce vessel speed to allow the animal to travel away from the vessel. If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator must assume that it is a NARW and execute the required vessel strike avoidance measures to avoid the animal. If an ESA-listed large whale is sighted within 656 feet (200 meters) of the forward path of a vessel, the vessel operator must initiate a full stop by reducing 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 ESA-listed large whale has moved beyond 1,640 feet (500 meters).	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from vessel encounters
BA-9	Vessel Strike Avoidance of Small Cetaceans and Seals	If pinnipeds or small delphinids of the genera Delphinus, Lagenorhynchus, Stenella, or 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.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals from vessel encounters

No	Measure	Description	Project Phase	Expected Effects
		For small cetaceans and seals, all vessels must maintain a minimum separation distance of 164 feet (50 meters) to the maximum extent practicable, except when those animals voluntarily approach the vessel. When marine mammals are sighted while a vessel is underway, the vessel operator must endeavor to avoid violating the 164-foot (50-meter) separation distance by attempting to remain parallel to the animal's course and avoiding excessive speed or abrupt changes in vessel direction until the animal has left the area, except when taking such measures would threaten the safety of the vessel or crew. If marine mammals are sighted within the 164-foot separation distance, the vessel operator must reduce vessel speed and shift the engine to neutral, not engaging the engines until animals are beyond 164 feet (50 meters) from the vessel.		
BA-10	Vessel Strike Avoidance of Sea Turtles	The Lessee must slow down to 4 knots if a sea turtle is sighted within 328 feet (100 meters) of the operating vessel's forward path. The vessel operator must then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 328 feet (100 meters) at which time the vessel may resume normal operations. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the individual at a speed of 4 knots or less until there is a separation distance of at least 328 feet (100 meters), at which time normal vessel operations may be resumed. Between June 1 and November 30, all vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., *Sargassum* lines or mats). In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas. All vessel crew members must be briefed on the identification of sea turtles and on regulations and best practices for avoiding vessel collisions. Reference materials must 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) must 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 so report.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on sea turtles from vessel encounters
BA-11	Reporting of All NARW Sightings	The Lessee must immediately report all NARWs observed at any time by PSOs or vessel personnel on any Project vessels, during any Project- related activity, or during vessel transit. Reports must be sent to: BOEM (at renewable_reporting@boem.gov) and BSEE (at protectedspecies@bsee.gov); the NOAA Fisheries 24-hour Stranding Hotline number (866-755-6622); the Coast Guard (via Channel 16); and WhaleAlert (through the WhaleAlert app at http://www.whalealert.org/). The report must include the time, location, and number of animals.	Pre-C, C, O&M, D	Enhanced measures to protect NARW
BA-12	Detected or Impacted Protected Species Reporting	The Lessee is responsible for reporting dead or injured protected species, regardless of whether they were observed during operations or due to Project activities. The Lessee must report any potential take, strikes, dead, or injured protected species caused by Project vessels or sighting of an injured or dead marine mammal or sea turtle, regardless of the cause, to the NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division (at nmfs.gar.incidental-take@noaa.gov), NOAA Fisheries 24-hour Stranding Hotline number (866-755-6622), BOEM (at renewable_reporting@boem.gov), and BSEE (at protectedspecies@bsee.gov). Reporting must be as soon as practicable but no later than 24 hours from the time the incident took place (Detected or Impacted 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. Reports must include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the e-mail would transmit a copy of the NMFS Take Report Form and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay.	Pre-C, C, O&M, D	Reporting to inform on the condition of ESA-listed species to provide critical information for endangered species to regulators

No	Measure	Description	Project Phase	Expected Effects
		At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.		
BA-13	Detected or Impacted Dead Non-ESA-Listed Fish	Any occurrence of at least 10 dead non-ESA-listed fish within established shutdown or monitoring zones must also be reported to BOEM (at renewable_reporting@boem.gov) as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting.	Pre-C, C, O&M, D	Reporting to inform on unusual mortality events for fish species to measure potentially unforeseen impacts
BA-14	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Time-of-Year Restriction	The Lessee must also follow the time-of-year enhanced mitigation measures specified in the applicable Biological Opinion. The Lessee must confirm adherence to time-of-year restrictions on pile driving in the pile-driving reports submitted with the FIR. If unanticipated delays due to weather or technical problems arise that necessitate extending pile driving through otherwise restricted time periods, SouthCoast must notify BOEM in writing at least 90 days in advance of any planned pile driving, detailing the circumstances that necessitate the pile driving. The Lessee must submit to BOEM (at renewable_reporting@boem.gov) for written concurrence an enhanced survey plan to minimize the risk of exposure of NARWs to pile-driving noise.. BOEM will review the enhanced survey plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the enhanced survey plan to BOEM's satisfaction and receive BOEM's written concurrence before any pile driving occurs.	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-15	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Weather, Nighttime, and Visibility Restrictions	The Lessee must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state), as described below, prevent visual monitoring of the full extent of the clearance and shutdown zones: • 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. • 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. In order to conduct pile driving at night and during periods of low visibility, the Lessee is required to submit two monitoring plans to NMFS and BOEM for review and approval 180 calendar days, but no later than 120 days, prior to the planned start of pile-driving: 1. **Nighttime Pile Driving Plan (NPDP)**: The NPDP will describe the methods, technologies, monitoring zones, and mitigation requirements for any nighttime pile driving activities. In the absence of an approved NPDP, all pile driving would be initiated during daytime and nighttime pile driving could only occur if unforeseen circumstances prevent the completion of pile driving during daylight hours and was deemed necessary to continue piling during the night to protect asset integrity or safety. 2. **Alternative Monitoring Plan (AMP)**: The AMP may include deploying additional observers, the use of alternative monitoring technologies (e.g., night vision, thermal, and infrared technologies), and the use of PAM 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. The AMP 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. The AMP and NPDP should include, but is not limited to the following information: • Identification of night vision devices (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights), if proposed for use to detect protected marine mammal and sea turtle species. • The AMP and NPDP 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	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise

No	Measure	Description	Project Phase	Expected Effects
		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 and nighttime 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 SouthCoast 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 and NPDP.		
BA-16	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: PSO Requirements	The Lessee must use PSOs provided by a third party. PSOs must have no Project- related tasks other than to observe, collect and report data, and communicate with and instruct relevant vessel crew regarding the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards). PSOs or any PAM operators serving as PSOs must have completed a commercial PSO training program for the Atlantic with an overall examination score of 80 percent or greater. The Lessee must provide training certificates for individual PSOs to BOEM upon request. And PSOs and PAM operators must be approved by NMFS before the start of a survey. Application requirements to become a NMFS-approved PSO for construction activities can be found online or for geological and geophysical surveys by sending an inquiry to nmfs.psoreview@noaa.gov. Specific PSO Requirements include: 1. At least one PSO must be on duty at all times as the lead PSO or as the PSO monitoring coordinator during pile driving. Total PSO coverage must be adequate to ensure effective monitoring to reliably detect whales and sea turtles in the identified clearance and shutdown zones and execute any pile driving delays or shutdown requirements. 2. At least one lead PSO must be present on each vessel during pile driving activities. PSOs on transit vessels must be approved by NMFS but need not be authorized as a lead PSO. Lead PSOs must have prior approval from NMFS as an unconditionally approved PSO. 3. All PSOs on duty must be clearly listed and the lead PSO identified on daily data logs for each shift. 4. A sufficient number of PSOs, consistent with the Biological Opinion and as prescribed in the final Incidental Take Authorization (ITA), must be deployed to record data in real time and effectively monitor the required clearance, shutdown, or monitoring zone for the Project. 5. The duties of these PSOs include visual surveys in all directions around a pile; PAM; and continuous monitoring of sighted NARWs. 6. Where applicable, the number of PSOs deployed must meet the NARW enhanced seasonal monitoring requirements. 7. A PSO must not be on watch for more than 4 consecutive hours and must be granted a break of no fewer than 2 hours after a 4-hour watch.	Pre-C, C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-17	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Monitoring Plan Requirements	The Lessee must submit a Pile-Driving Monitoring (PDM) Plan for review to BOEM (at renewable_reporting@boem.gov), BSEE (at OSWsubmittals@bsee.gov), and NMFS 180 calendar days, but no later than 120 days, before beginning the first pile-driving activities for the Project. DOI will review the PDM Plan and provide any comments on the plan within 90 calendar days of its submittal. The Lessee must resolve all comments on the PDM Plan to DOI's satisfaction before implementing the plan. If DOI provides no comments on the PDM Plan within 90 calendar days of its submittal, then the Lessee may conclusively presume DOI's concurrence with the plan. The PDM Plan must:	C	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from underwater noise

No	Measure	Description	Project Phase	Expected Effects
		1. Contain information on the visual and PAM components of the monitoring describing all equipment, procedures, and protocols; 2. The PAM system must demonstrate a near-real-time capability of detection to the full extent of the 120 or 160 dB distance from the pile-driving location; 3. The PAM plan must include a detection confidence that a vocalization originated from within the clearance and shutdown zones to determine that a possible NARW has been detected. Any PAM detection of a NARW within the clearance/shutdown zone surrounding a pile must be treated the same as a visual observation and trigger any required delays in pile installation. 4. Ensure that the full extent of the harassment distances from piles are monitored for marine mammals and sea turtles to document all potential take; 5. Include number of PSOs or Native American monitors, or both, that will be used, the platforms or vessels upon which they will be deployed, and contact information for the PSO providers; 6. Include measures for enhanced monitoring capabilities in the event that poor visibility conditions unexpectedly arise, and pile driving cannot be stopped. 7. Include an Alternative Monitoring Plan that provides for enhanced monitoring capabilities in the event that poor visibility conditions unexpectedly arise, and pile driving cannot be stopped. The Alternative Monitoring Plan must also include measures for deploying additional observers, using night vision goggles, or using PAM with the goal of ensuring the ability to maintain all clearance and shutdown zones in the event of unexpected poor visibility conditions. Describe a communication plan detailing the chain of command, mode of communication, and decision authority must be described. PSOs as determined by NMFS and BOEM must be used to monitor the area of the clearance and shutdown zones. Seasonal and species-specific clearance and shutdown zones must also be described in the PDM Plan including time-of-year requirements for NARWs. A copy of the approved PDM Plan must be in the possession of the lessee representative, the PSOs, impact-hammer operators, and any other relevant designees operating under the authority of the approved COP and carrying out the requirements on site.		
BA-18	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Soft Start for Pile Driving	The Lessee must implement soft start techniques for all impact pile-driving, both at the beginning of a monopile installation and at any time following the cessation of impact pile-driving of 30 minutes or longer. The soft start procedure must include a minimum of 20 minutes of 4-6 strikes/minute at 10-20 percent of the maximum hammer energy.	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-19	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Sound Field Verification Plan	The Lessee must ensure that distances to the auditory injury (i.e., harm) or behavioral harassment threshold (Level A and Level B harassment respectively) for marine mammals, the harm or behavioral harassment thresholds for sea turtles, or the harm or behavioral disturbance thresholds for Atlantic sturgeon that are identified in the NMFS BiOp are no larger than those modelled assuming 10 dB re 1 μPa noise attenuation is met by conducting field verification during pile-driving. The Lessee must submit a Sound Field Verification Plan (SFVP) for review and comment to the USACE (at CENAE-R-OffshoreWind@usace.army.mil), BOEM (at renewable_reporting@boem.gov), and NMFS GARFO-PRD (at nmfs.gar.incidental-take@noaa.gov) 180 calendar days, but no later than 120 days, before beginning the first pile-driving activities for the Project. The SFVP must provide details for monitoring pile driving sound levels including thorough and abbreviated SFV, required reporting, adaptive attenuation measures, and monitoring measures consistent with Terms and Conditions of the NMFS BiOp issued under the ESA and requirements of the LOA issued under the MMPA. It is anticipated that conditions similar to those agreed to by BOEM and NMFS in recent biological opinions will be required.[13] The Lessee must send all raw SFV PAM data to the NCEI Passive Acoustic Data archive within 12 months following the completion of WTG/ESP foundation installation and the Lessee must follow NCEI guidance for packaging the data and metadata. DOI will review the SFVP and provide any comments on the plan within 45 calendar days of its submittal. The Lessee must resolve all comments on the SFVP to DOI's satisfaction before	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise

[3] For full description of example sound field verification conditions, see Reasonable and Prudent Measure 1, Term and Condition 2 in NMFS. 2024. Construction, Operation, Maintenance, and Decommissioning of the New England Wind Offshore Energy Project (Lease OCS-A 0534). Biological Opinion. National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office February 16, 2024.

No	Measure	Description	Project Phase	Expected Effects
		implementing the plan. The Lessee may conclusively presume DOI's concurrence with the SFVP if DOI provides no comments on the plan within 90 calendar days of its submittal. The plan(s) must describe how the first three piled installation sites and installation scenarios (i.e., hammer energy and number of strikes) are representative of the rest of the piled installations and, therefore, why these piled installations would be representative of the remaining piled installations. If the monitored pile locations are different from the ones used for exposure modelling, the Lessee must provide a justification for why these locations are representative of the modeling. In the case that these sites are not determined to be representative of all other pile installation sites, the Lessee must include information on how additional piles/sites will be selected for sound field verification (SFV). The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS GARFO. The Lessee must conduct additional field measurements if it installs piles with a diameter greater than the initial piles, if it uses a greater hammer size or energy, or if it measures any additional foundations to support any request to decrease the distances specified for the clearance and shutdown zones. The Lessee must implement the SFVP requirements for verification of noise attenuation for at least 3 foundations of each pile type, in consultation with NMFS, to consider reducing zone distances (see BA-25). The Lessee must ensure that locations identified in the SFVP for each pile type are representative of other piles of that type to be installed and that the results are representative for predicting actual installation noise propagation for subsequent piles. The SFVP must describe how the effectiveness of the sound attenuation methodology will be evaluated. The SFVP must be sufficient to document impacts in Level B harassment zones for marine mammals and injury and behavioral disturbance zones for sea turtles and Atlantic sturgeon. The Noise Attenuation System (NAS) inspection/performance report must be submitted to BOEM and BSEE within 72 hours of the performance test, which must occur prior to the first pile installation as well as any additional piles for which SFV is conducted. 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.		
BA-20	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Adaptive Refinement of Clearance Zones, Shutdown Zones, and Monitoring Protocols	The Lessee must reduce any unanticipated impacts on marine mammals and sea turtles by adjusting pile-driving monitoring protocols for clearance and shutdown zones, taking into account weekly monitoring results (see BA-28). Any proposed changes to monitoring protocols must be concurred with by DOI and NMFS before those protocols are implemented. Any reduction in the size of the clearance and shutdown zones for each foundation type must be based on at least 3 measurements submitted to BOEM and NMFS for review. For each 4,921 feet (1,500 meters) that a clearance or shutdown zone is increased based on the results from SFVP, the Lessee must deploy additional platforms and must deploy additional observers on those platforms. Should the shutdown zone for sei, fin, humpback, and sperm whales be decreased the full extent of the Level B harassment distance must be monitored using PAM and visual observations. Decreases in the distance of the clearance or shutdown zones for NARW and sea turtles are not permitted.	C	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals and sea turtles from underwater noise
BA-21	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Clearance Zones (No-go Zones) for Sea Turtles	The Lessee must minimize the exposure of ESA-listed sea turtles to noise that may result in injury or behavioral disturbance during pile-driving operations by tasking the PSOs to establish a clearance and shutdown zone for sea turtles during all pile-driving activities that is no less than 820.2 feet (250 meters) between 60 minutes before pile-driving activities, during pile driving and 30 minutes post-completion of pile-driving activity. Adherence to the 820.2-foot (250-meter) clearance and shutdown zones must be confirmed in the PSO reports.	C	Increase effectiveness of mitigations to avoid or minimize impacts on sea turtles from underwater noise
BA-22	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Impact Pile-Driving Clearance Zones (No-go Zones) for Marine Mammals	The Lessee must use visual monitoring by three PSOs and PAM during impact pile-driving activities following the standard protocols and data collection requirements. The Lessee must ensure that three PSOs are on duty on the impact pile driving platform and three PSOs are on duty on each dedicated PSO vessel and establish the following clearance zones for NARWs to be used between 60 minutes before pile-driving activities and 30 minutes post-completion of pile-driving activity: • The Lessee must establish a clearance zone of 1.37 miles (2.2 kilometers) for large whales other than NARW using visual monitoring for impact pile driving. • The Lessee must also establish a PAM clearance zone of 3.1 miles (5 kilometers) and a PAM shutdown zone of 1.23 miles (2 kilometers) for NARWs.	C	Increase effectiveness of mitigations to avoid or minimize impacts on marine mammals from underwater noise

No	Measure	Description	Project Phase	Expected Effects
		• Impact pile driving activity must be delayed when a NARW is visually observed by PSOs at any distance from the pile. Impact pile driving for all foundations must be delayed upon a confirmed PAM detection of a NARW, if the detection is confirmed to have been located within the 5 km clearance zone. • No pile driving may begin unless all clearance zones have been free of NARW for 60 minutes immediately before pile driving. The Lessee must deploy a real-time PAM system designed and verified to maintain a PAM clearance zone of 3.1 miles (5 km) and a shutdown zone of 1.23 miles (2 km) for all monopile foundations. • Real-time PAM must begin at least 60 minutes before pile driving to monitor a 3.1 mile (5 km) clearance zone. • The real-time PAM system must be configured to ensure that the PAM operator is able to review acoustic detections within approximately 30 minutes of the original detection in order to verify whether a NARW has been detected. • Impact pile driving must be suspended upon a confirmed PAM NARW vocalization within the PAM shutdown Zone detected and identified as a NARW. The detection will be treated as a NARW detection for mitigation purposes.		
BA-23	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Vibratory Pile-Driving Clearance Zones (No-go Zones) for ESA-listed Species and Marine Mammals	The Lessee must use visual monitoring by three PSOs during vibratory pile-driving activities. The Lessee must ensure that PSOs are on a dedicated PSO vessel and establish clearance zones for NARWs to be used between 60 minutes before pile-driving activities and 30 minutes post-completion of pile-driving activity. For all ESA-listed Mysticete whales and sperm whales, a clearance zone of 4,921 feet (1,500 meters) is to be established. For sea turtles, a clearance zone of 1,640 feet (500 meters) is to be established. Vibratory pile driving may begin only after PSOs have confirmed all clearance zones are clear of marine mammals. Vibratory pile driving must be suspended if a marine mammal is visually observed by PSOs within the shutdown zone. At all times of the year, any unidentified whale sighted by a PSO within 6,562 feet (2,000 meters) of the pile must be treated as if it were a NARW and trigger any required pre-construction delay or shutdowns during pile installation. Vibratory pile driving may begin only if all clearance zones are fully visible (e.g., not obscured by darkness, rain, fog, or snow) for at least 30 minutes as determined by the lead PSO. If conditions such as darkness, rain, fog, or snow prevent the visual detection of marine mammals in the clearance zones, construction activities must not begin until the full extent of all clearance zones are fully visible as determined by the lead PSO.	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-24	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Noise Mitigation for Pile Driving	The Lessee must apply noise reduction technologies during all pile driving activities to minimize marine species noise exposure. The range measured to the Level B harassment threshold when noise mitigation devices are in use must be consistent with or less than the range modeled assuming 10 dB attenuation, determined via sound field verification of the modeled isopleth distances (e.g., Level B harassment distances). If a bubble curtain is used, the following requirements apply: 1. Bubble curtains must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. 2. 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. 3. No parts of the ring or other objects may prevent full seafloor contact of the lowest bubble ring. The Lessee must train personnel in the proper balancing of air flow to the bubblers. The Lessee must submit an inspection and performance report to DOI within 72 hours following the performance test. Any modifications to attenuation devices to meet the performance standards must occur before impact driving occurs and maintenance or modifications completed must be included in the report. The Lessee must ensure PSOs follow all pile driving reporting instructions and requirements.	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-25	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-	The Lessee must measure pile-driving noise in the field for at least three foundations of each pile type and submit initial results to NMFS, USACE, and BOEM (at renewable_reporting@boem.gov) as soon as they are available. BOEM will discuss the results as soon as feasible. The Lessee	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise

No	Measure	Description	Project Phase	Expected Effects
	Driving Noise Reporting and Clearance or Shutdown Zone Adjustment	may request modification of the clearance and shutdown zones based on these results but must meet or exceed minimum distances for threatened and endangered species specified in the Biological Opinion (e.g., 3,280 feet [1,000 meters] for large whales and 1,640 feet [500 meters] for sea turtles). If the field measurements indicate that the isopleths for noise exposure are larger than those considered in the approved COP, the Lessee must coordinate with BOEM, BSEE, NMFS, and USACE to implement additional sound attenuation measures or larger clearance or shutdown zones before driving any additional piles. NMFS does not anticipate considering any reductions in the clearance or shutdown zones for NARWs.		
BA-26	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Work Within a Slow Zone	If a visually triggered NARW Slow Zone overlaps with the NARW Shutdown Zone, the PAM system detection must extend to the largest practicable detection zone. PSOs must treat any PAM detection of NARWs in the clearance and shutdown zones the same as a visual detection and call for the required delays or shutdowns in pile installation.	C	Increase effectiveness of mitigations to avoid or minimize impacts on NARW from underwater noise
BA-27	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Submittal of Raw Field Data Collected for Marine Mammals and Sea Turtles in the Pile-Driving Shutdown Zone	Within 24 hours of detection, the Lessee must report to BOEM (at renewable_reporting@boem.gov) and BSEE (at protectedspecies@bsee.gov) the sighting of any marine mammal or sea turtle in the shutdown zone that results in a shutdown or a power-down. In addition, PSOs must submit the raw data collected in the field and daily report forms including the date, time, species, pile identification number, GPS coordinates, time and distance of the animal when sighted, time the shutdown or power-down occurred, behavior of the animal, direction of travel, time the animal left the shutdown zone, time the pile driver was restarted or powered back up, and any photographs.	C	Record the effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-28	Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Weekly and Final Pile-Driving Reports	The Lessee must submit weekly PSO and PAM monitoring reports to DOI and NMFS during pile-driving. Weekly reports must document the daily start and stop times of all pile-driving, the daily start and stop times of associated observation periods by the PSOs, details on the deployment of PSOs, and all detections of marine mammals and sea turtles. The weekly reports must be submitted to BOEM (at renewable_reporting@boem.gov), BSEE (at OSWsubmittals@bsee.gov) and NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division (at nmfs.gar.incidental- take@noaa.gov) every Wednesday during construction for the previous week (Sunday through Saturday) of monitoring of pile-driving activity. Weekly monitoring reports must include: 1. Summaries of pile-driving activities and piles installed including, start and stop times, pile locations, and PSO coverage; 2. Vessel operations (including port departures, number of vessels, type of vessel(s), and route); 3. All protected species sightings; 4. Vessel strike-avoidance measures taken; and any equipment shutdowns or takes that may have occurred. Weekly reports can consist of raw data. Required data and reports provided to DOI may be archived, analyzed, published, and disseminated by BOEM. PSO data must be reported weekly (Sunday through Saturday) from the start of visual and/or PAM efforts during pile-driving activities, and every week thereafter until the final reporting period upon conclusion of pile-driving activity. Any editing, review, and quality assurance checks must be completed only by the PSO provider prior to submission to NMFS and DOI. The Lessee must submit to DOI at renewable_reporting@boem.gov and OSWsubmittals@bsee.gov a final summary report of PSO monitoring 90 days following the completion of pile driving.	C	Record the effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise
BA-29	Marine Debris Awareness and Elimination: Marine Debris Awareness Training	The Lessee must ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities must continue to develop and use a marine trash and debris awareness training	Pre-C, C, O&M, D	Increase the effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from marine debris

No	Measure	Description	Project Phase	Expected Effects
		and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: 1. Viewing of either a video or slide show by the personnel specified above; 2. An explanation from management personnel that emphasizes their commitment to the requirements; 3. Attendance measures (initial and annual); and 4. 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 OSWsubmittals@bsee.gov).		
BA-30	Marine Debris Awareness and Elimination: Marine Debris Reporting	The Lessee must report to DOI (using the email address listed on DOI's most recent incident reporting guidance) all lost or discarded marine trash and debris. This report must be made monthly and submitted no later than the fifth day of the following month. The Lessee is not required to submit a report for those months in which no marine trash and debris was lost or discarded. In addition, the Lessee must submit a report within 48 hours of the incident (48-hour Report) if the marine trash or debris could: (a) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to marine trash or debris that could entangle or be ingested by marine protected species; or (b) significantly interfere with OCS uses (e.g., because the marine trash or debris is likely to snag or damage fishing equipment or presents a hazard to navigation). The information in the 48-hour report must be the same as that listed for the monthly report, but only for the incident that triggered the 48-hour Report. The Lessee must report to DOI via email to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWsubmittals@bsee.gov) if the object is recovered and, as applicable, describe any substantial variance from the activities described in the Recovery Plan that were required during the recovery efforts. The Lessee must include and address information on unrecovered marine trash and debris in the description of the site clearance activities provided in the decommissioning application required under 30 C.F.R. § 585.906. Materials, equipment, tools, containers, and other items used in OCS activities which are of such shape or properly secured to prevent loss overboard. All markings must clearly identify the owner and must be durable enough to resist the effects of the environmental conditions to which they may be exposed.	Pre-C, C, O&M, D	Record the effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from marine debris
BA-31	Marine Debris: 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 10 different WTGs in the SouthCoast Wind Lease Area annually. Survey design and effort may be modified based upon previous survey results with review and concurrence by DOI. 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 OSWsubmittals@bsee.gov) in an annual report, submitted by April 30 for the preceding calendar year. Reports must be submitted in Word format. Photographic and videographic materials will be provided on a drive in a lossless format such as TIFF or Motion JPEG 2000. Reports must include daily survey reports that include the survey date, contact information of the operator, 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. BMPs will be coordinated with NOAA's marine debris program.	O&M, D	Record the effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from marine debris, particularly ghost gear
BA-32	Establishment of Shutdown Zones for Vibratory Pile Driving	Ensure that vibratory pile-driving operations are carried out in a way that minimizes the exposure of listed sea turtles to noise that may result in injury or behavioral disturbance, PSOs will establish a 1,640-foot (500-meter) shutdown zone for all pile-driving activities. Adherence to the 1,640-foot (500-meter) shutdown zones must be reflected in the PSO reports. Any visual detection of sea turtles the 500-meter shutdown zones must trigger the required shutdown in pile	C	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species from underwater noise

No	Measure	Description	Project Phase	Expected Effects
		installation. Upon a visual detection of a sea turtles entering or within the shutdown zone during pile-driving, SouthCoast Wind must shut down the pile-driving hammer (unless activities must proceed for human safety or for concerns of structural failure) from when the PSO observes, until: 1) The lead PSO verifies that the animal(s) voluntarily left and headed away from the clearance area; or 2) 30 minutes have elapsed without re-detection of the sea turtle(s) by the lead PSO Additionally, if shutdown is called for but SouthCoast Wind determines shutdown is not technically feasible due to human safety concerns or to maintain installation feasibility, reduced hammer energy must be implemented, when the lead engineer determines it is technically feasible to do so.		
BA-33	Sea turtle Disentanglement	In the event that sea turtles become entangled, the NMFS stranding hotline must be contacted immediately. Vessels deploying fixed gear (e.g., pots/traps) must have adequate disentanglement equipment onboard, such as a (i.e., knife and boathook) onboard. Any disentanglement must occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on sea turtles from marine debris
BA-34	Sea Turtle/Atlantic Sturgeon Identification and Data Collection	Any sea turtles or Atlantic sturgeon caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Biological data collection, sample collection, and tagging activities must be conducted as outlined below. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation. A. The Sturgeon and Sea Turtle Take Standard Operating Procedures must be followed (https://media.fisheries.noaa.gov/2021-11/ Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). b. Survey vessels must 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). This reader must be used to scan any captured sea turtles and sturgeon for tags, and any tags found must be recorded on the take reporting form (see below). c. Genetic samples must 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 must be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dam-migration/ sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips must be sent to a NMFS-approved laboratory capable of performing genetic analysis and assignment to DPS of origin. SouthCoast Wind must cover all reasonable costs of the genetic analysis. Arrangements for shipping and analysis must be made before samples are submitted and confirmed in writing to NMFS within 60 days of the receipt of the Project BiOp with ITS. Results of genetic analyses, including assigned DPS of origin must be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms must 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%20 to%20Use.xlsx?nullhttps://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. D. All captured sea turtles and Atlantic sturgeon must be documented with required measurements and photographs. The animal's condition and any marks or injuries must be described. This information must be entered as part of the record for each incidental take. Particularly, a NMFS Take Report Form must 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.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on ESA-listed species by gathering biological data

No	Measure	Description	Project Phase	Expected Effects
BA-35	Sea Turtle/Atlantic Sturgeon Handling and Resuscitation Guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: a. Priority must be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear being used. Handling times for these species must be minimized, and if possible, kept to 15 minutes or less to limit the amount of stress placed on the animals. b. All survey vessels must have onboard copies of the sea turtle handling and resuscitation requirements (found at 50 CFR 223.206(d)(1)) before begging any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures must be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during survey activities. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff must 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 survey staff are unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG must 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 and managed in accordance with handling instructions provided by the Hotline before transfer to a rehabilitation facility. d. Survey staff must attempt resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). e. If appropriate cold storage facilities are available on the survey vessel, any dead sea turtle or Atlantic sturgeon must be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore unless NMFS indicates that storage is unnecessary, or storage is not safe. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey must ultimately be released according to established protocols including safety considerations.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on ESA listed species from unsafe handling
BA-36	Lost Survey Gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWsubmittals@bsee.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.	C, O&M, D	Increase effectiveness of mitigations to avoid or minimize impacts on sea turtles from marine debris
BA-37	Minimize Risk During Buoy Deployment, Operations, and Retrieval	The Lessee must ensure any mooring systems used during survey activities must be designed to prevent potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below: • The Lessee must ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device. • All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species. • Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose. • During all buoy deployment and retrieval operations, buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. Additionally, PSOs or trained project personnel (if PSOs are not required) should monitor for listed species in the area prior	C,O,D	Minimize the risk of entanglement for ESA-listed species

No	Measure	Description	Project Phase	Expected Effects
		to and during deployment and retrieval and work should be stopped if listed species are observed within 500 meters of the vessel to minimize entanglement risk. • If a live or dead marine protected species becomes entangled, operators must immediately contact the applicable stranding network coordinator using the reporting contact details (see BA-12) and provide any on-water assistance requested • All buoys must be properly labeled with owner and contact information.		
BA-38	UXO Detonation – Visual and Acoustic Monitoring, Clearance Zones	The Lessee must comply with applicant-proposed measures for UXO detonations in addition to BOEM-required measures for ESA-listed species as summarized below: • Comply with modified visual and acoustic monitoring measures for UXO detonations: Two PSO vessels, each with three PSOs on watch, will visually monitor the UXO clearance zone at least 60 minutes before a detonation event, during the event, and for a period of 30 minutes after the event. • The dedicated APSO must acoustically monitor to a minimum radius of 8.8 miles (14,100 meters) around the detonation site. The Lessee must comply with applicant-proposed clearance zones for UXO detonations for the PTS distances for listed species be established for the specified net explosive weight and associated PTS threshold exposure distance.	C	Minimize impacts to marine mammals and sea turtles from UXO detonations

AMP = alternative monitoring plan; BiOP = biological opinion; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; C =construction; COP = Construction and Operation plan; dB = decibel; D = Decommissioning; DMA = dynamic management area; DOI = Department of the Interior; DPS = distinct population segment; ESA = Endangered Species Act; GARFO = Greater Atlantic Regional Fisheries Office; HVAC = high voltage alternating current; HVDC = high voltage direct current; ITA = incidental take authorization; JPEG = joint photographic experts group; km/hr = kilometer per hour; kHz = kilohertz; lb = pound; LoC = Letter of Concurrence; m = meter; MMPA LOA = Marine Mammal Protection Act Letter of Authorization; mph = miles per hour; NARW = north Atlantic right whale; NAS = Noise Attenuation System; NAVTEX = NAVigational TeleX; NMFS = National Marine Fisheries Service; NMS = noise mitigation system; NOAA = National Oceanic and Atmospheric Administration; NPDP = Nighttime Pile Driving Plan; O&M = operations & maintenance; OCS = outer continental shelf; OSP = offshore substation platform; PAM = Passive acoustic monitoring; PDC = project design criteria; PDM = Pile-Driving Monitoring; PIT = passive integrated transponder; PSO = protected species observer; PTS = permanent threshold shift; RWSAS = Right Whale Sighting Advisory System; SFV = sound field verification; SFVP = sound field verification plan; SMA = seasonal management area; STDN = sea turtle disentanglement network; USACE = United States Army Corps of Engineers; UXO = unexploded ordinance WTG = wind turbine generator

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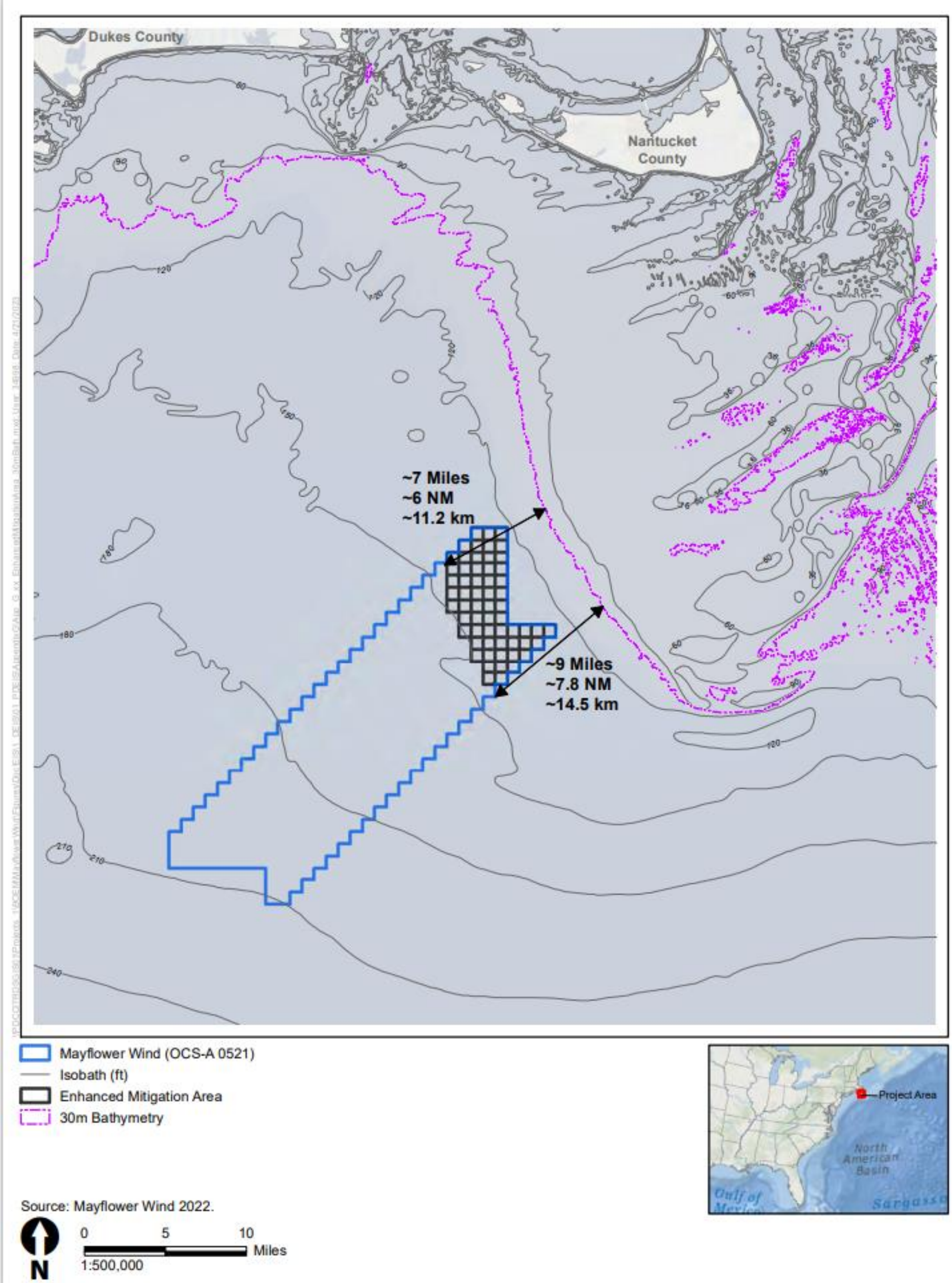
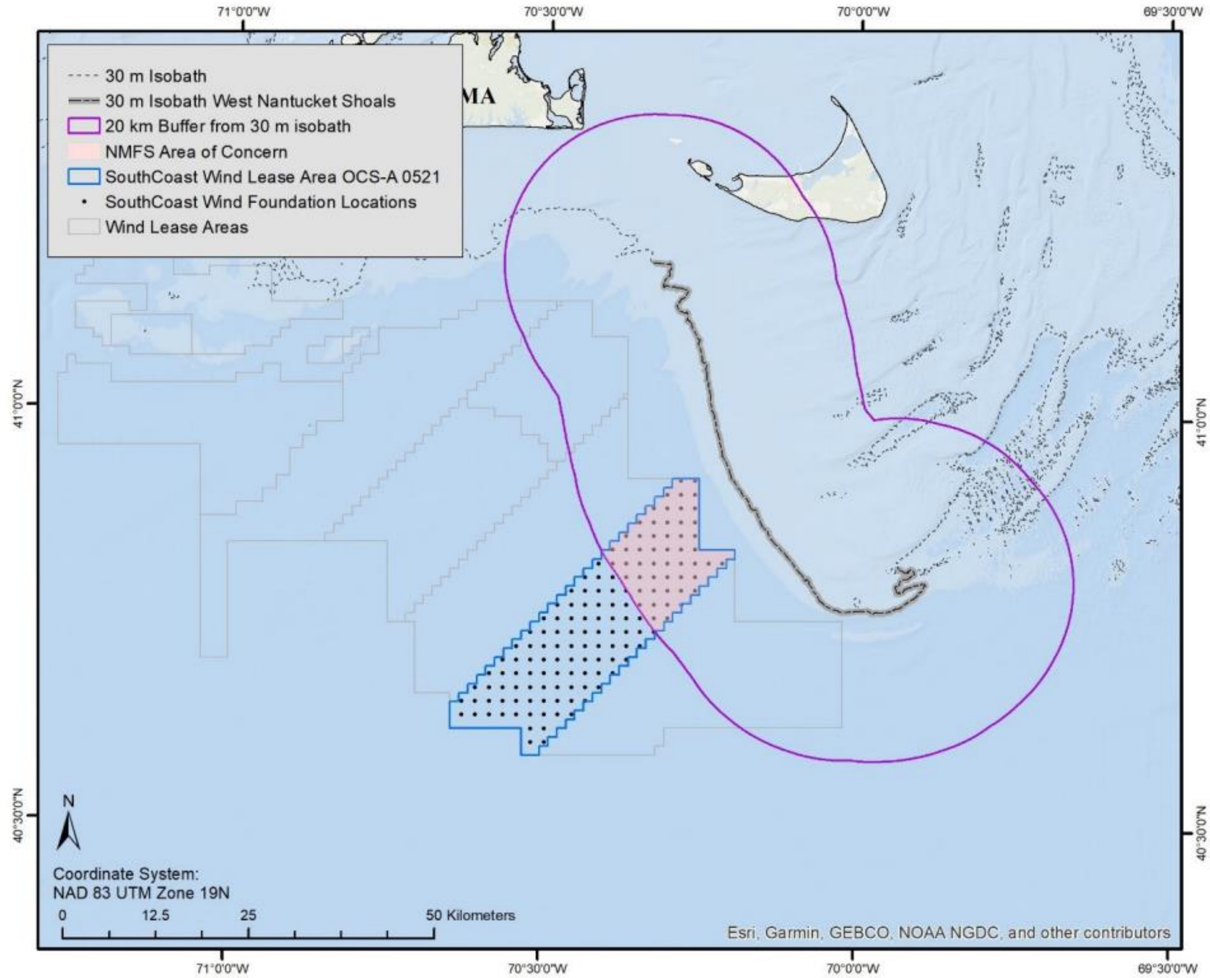


Figure 3.3-1. Enhanced mitigation area



Source: SouthCoast Wind 2024

Figure 3.3-2. Map showing the OCS-A 0521 Lease Area, 30-meter isobath on Nantucket Shoals, and a 20-kilometer buffer around that line creating the NMFS defined area of concern

4. 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 the following:

- All federal, state, or private actions and other human activities that have influenced the condition of 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 CFR 402.02).

SouthCoast Wind conducted detailed surveys of the Project area during COP development. Those surveys are the most current information available for characterizing baseline conditions within the Project area and are relied upon here and supported by other appropriate sources of information where available.

Marine ecosystems in the Action Area 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 entire Action Area is the Temperate Northern Atlantic Realm, Cold Temperate Northwest Atlantic Province, Virginian Ecoregion. The environmental baseline for benthic habitats also incorporates updated recommendations from the National Oceanic and Atmospheric Administration (NOAA) (2021) regarding mapping fish habitat.

The Action Area includes marine (i.e., subsurface), airborne (e.g., airborne noise), and the upland or terrestrial components of the Project footprint. However, the NMFS ESA-listed species considered in this BA do not occur within the terrestrial components of the Action Area, and the projected impacts on upland habitats resulting from the onshore components of the Proposed Action would have no measurable effect on aquatic habitats used by ESA-listed species. The following discussion provides information on those elements of the environment relevant to the species covered in this BA and the project related IPFs.

4.1 Benthic Habitat

SouthCoast Wind collected Sediment Profile Imaging (SPI)/Plan View (PV) imagery data, benthic grab samples in addition to geophysical, geotechnical, and some submerged aquatic vegetation (SAV) survey data throughout the Project area. These data indicate that the seabed in the Lease Area is mostly flat with gentle slopes ranging from less than 1.0° to 4.9°. The central section of the Lease Area comprises ridges with moderate slopes (5.0° to 9.9°) and shallow channels. Sediments from grab samples within the Lease Area were largely classified as CMECS Subclass Fine Unconsolidated Substrate, or dominated by sand or finer sediment size (< 5 percent gravel). Only one sample was classified as Coarse Unconsolidated Substrate (≥ 5 percent gravel). The Lease Area was mainly soft bottom habitat with little relief and no complex habitat-forming features. Total organic carbon (TOC) was low with the majority of samples containing less than 1 percent TOC (COP Volume 2 and Appendix M, SouthCoast Wind 2023). Benthic epifauna were sampled by beam trawl across the Massachusetts offshore wind Lease Area with sand shrimp and sand dollars comprising 88 percent of individuals collected (Guida et al. 2017). Mobile crustaceans and mollusks were dominant in 2020 benthic samples and are commonly associated with the soft sediments of the Lease Area. Infaunal communities of the Lease Area consisted mainly of soft-sediment burrowing infauna, with the eastern portion consisting of clam beds and tube-building Ampelisca beds. The western portion of the Lease Area also contained Ampelisca beds, as well as small surface-burrowing polychaete worm beds. Results of a seagrass and macroalgae evaluation of the Project area found no SAV in the Lease Area (COP Volume 2 and Appendix K, SouthCoast Wind 2023).

Similar to the Lease Area, the southern portion of the Falmouth ECC (between the Lease Area and the Muskeget Channel) consisted mainly of fine and soft sediments. Samples in this southern section were mainly Fine Unconsolidated sediment, with three samples of Coarse Unconsolidated sediment (≥ 5 percent gravel). Most samples (approximately 90 percent) were sand, with three samples consisting of Muddy Sand. Further sand classification indicated a transition of Fine/Very Fine Sand to Medium and Very Coarse/Coarse Sand as sampling occurred more north and away from the Lease Area. The only complex habitats observed were three gravelly samples. TOC was less than 1 percent in all samples. The infauna sampled along the southern Falmouth ECC closely matched the eastern Lease Area, dominated by clam beds and large tube-building fauna. The northern Falmouth ECC sediment samples were more variable, with a further transition to coarser sediments as the corridor proceeds north towards landfall. Gravelly samples dominated south of the Nantucket Sound Main Channel, with all samples within the Nantucket Sound Main Channel classified as sand. Complex habitat was observed in the remaining samples north of the Nantucket Main Channel, with two samples classified as Biogenic Shell Substrate (*Crepidula* reef). Some gravel pavement was noted in the SPI/PV images, and gravel/gravelly samples were observed throughout the northern section of the Falmouth ECC. TOC was undetectable in the majority of samples, with one sample containing slightly above 1 percent. The northern Falmouth ECC had a heterogenous array of species including soft-sediment bryozoans and mobile burrowing crustaceans (COP Volume 2 and Appendix M, SouthCoast Wind 2023).

Benthic surveys were conducted along the Brayton Point ECC in Summer 2021 and Spring 2022. Sediments followed similar patterns as the Falmouth ECC, with finer sediments in the southern section near the Lease Area becoming coarser as sampling proceeded north. In federal waters, over 90 percent of benthic habitat was mapped as sand or finer (Appendix M.3; SouthCoast Wind 2023). Sand substrates in the offshore portion of the Brayton Point ECC are expected to support mobile taxa common to soft sediments, including the bivalves, crustaceans, echinoderms, gastropods, oligochaetes, and polychaetes similar to those observed in the southern Falmouth ECC. Gravelly Sand to Sandy Gravel, including Boulders with attached macroalgae and bryozoans, were present in the Rhode Island Sound where an area of glacial till southwest of Martha’s Vineyard provides heterogenous substrate and hardbottom substrate. Sand or finer sediments dominated Rhode Island state waters as well with 88 percent of the benthic habitat, and coarse sediments consisting of 8.5 percent Mixed-Sized Gravel in Muddy Sand/Sand, 3.1 percent Glacial Moraine A, and 0.1 percent Bedrock. Additionally, 22.2 percent of the Rhode Island state waters had *Crepidula* Substrate as a CMECS Substrate classifier, and 3.1 percent had Boulder Field(s) as a Substrate classifier (Appendix M.3; SouthCoast Wind 2023). Sediments in the Sakonnet River are finer sands to silts with isolated mounds associated with *Crepidula* reefs, and areas of boulders, including anthropogenic rock dumps that provide hard bottom habitat to a complex community of structure-associated mobile taxa, including bivalves, bryozoans, echinoderms, gastropods, and polychaetes, as well as attached shellfish and encrusting organisms.

Submerged aquatic vegetation beds were identified at the Falmouth landfall areas from a review of eelgrass field surveys completed in August 2020. The seagrass and macroalgae characterization surveys did not identify SAV in the southern portion of the Falmouth ECC, but macroalgae was identified in approximately two-thirds of the survey locations during benthic grabs of the northern section of the Falmouth ECC. A previously unmapped section of interpreted SAV was identified near the Aquidneck Island landfall of the Brayton Point ECC. Sampling within the Brayton Point ECC showed soft sediment fauna was the dominant CMECS biotic subclass observed along the entire Brayton Point ECC, characterized by clam beds, larger tube-building, mobile crustaceans, and surface-burrowing fauna, with much more diversity in the southern portion of the ECC (COP Volume 2 and Appendix M, SouthCoast Wind 2023).

Analytical modeling and qualitative assessment were employed to investigate scour potential in the Project area. Geotechnical data, site-specific bathymetric data, publicly available data, and site-specific conditions from a high resolution model developed specifically for the Proposed Action revealed very limited potential for background sediment transport activity across the Lease Area and along the southern part of the ECCs. Bed shear stresses resulting from currents and waves exceed critical shear stresses for initiation of sediment movement during a very low percentage of the time, and no significant bedform or other presently active geomorphological feature is observed from the review of the currently available data.

In the vicinity of the Vineyard and Nantucket Sounds and Muskeget Channel, much stronger currents and waves occur along the shallower sections of the export cable routes. These are associated with widespread evidence of sediment transport activity and bedforms such as megaripples and sand waves, with height locally reaching up to 13 feet (4 meters). Sediment mobility along the export cable routes varies over a wide range, with significant mobility associated with sand waves and shoals where strong tidal currents occur, especially in the vicinity of the Vineyard and Nantucket Sounds and Muskeget Channel. Scour is more likely to be associated with natural processes than caused by the cables themselves, provided the latter is buried such that it is not exposed to seabed currents. The burial depth will have to be determined to prevent the potential re-exposure of the cables in areas of migrating sand waves.

4.2 Pelagic Habitat

The Action Area includes coastal and offshore areas in southern New England waters, as well as offshore and coastal areas utilized by vessels transiting to ports north to Canada and south to ports in the Gulf of Mexico. This section presents water quality data for federal waters, mostly associated with the Lease Area, and offshore waters for the ECCs. The aquatic component of the Project area is located in transitional waters that separate Narragansett Bay and Long Island Sound from the Atlantic OCS. The Falmouth ECC state waters include Nantucket Sound, which is located between the south coast of Massachusetts and the Islands of Martha’s Vineyard and Nantucket. The Brayton Point ECC state waters include the Sakonnet River, located east of Narragansett Bay in Rhode Island, which connects Mount Hope Bay to the Rhode Island Sound. Mount Hope Bay is located between both Massachusetts and Rhode Island and is in the vicinity of the proposed export cable landfall locations at Brayton Point. Water quality of coastal marine waters in the region is summarized below, with more detailed water quality information and data sources included in the SouthCoast COP Appendix H (SouthCoast Wind 2023).

Within the Lease Area, water depths range from 122 to 208 feet (37.1 to 63.5 meters; Figure 4.2-1) (COP Volume 2 and Appendix E, SouthCoast Wind 2023). Along the Falmouth and Brayton Point export cable routes, water depths vary between 0 and 160 feet (0 and 49.8 meters) and 0 and 136 feet (0 and 41.5 meters), respectively. The Falmouth ECC is subject to strong ebb and flood tidal currents, from Falmouth, Massachusetts, to where it passes between Martha’s Vineyard and Nantucket Islands. Beyond the islands, and into the Lease Area, offshore hydrodynamic conditions are considered storm dominated with relatively weaker bottom currents driven by waves and circulation (COP Volume 2 and Appendix E3, SouthCoast Wind 2023, Goff et al. 2005). Circulation patterns in the region 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 2010). Currents generally flow westward across the shelf south of the islands, although a tidally driven anticyclonic flow encircles Nantucket

Shoals, with tidal mixing maintaining cool water temperatures on the shoals throughout the year whereas the rest of the region becomes stratified during the summer months (Wilkin 2006).

The Project area 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). Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011), which is subjected to highly seasonal variation in temperature, stratification, and productivity. There is a persistent frontal zone near Nantucket Shoals, which marine vertebrates often use for foraging and migration as they can aggregate prey (Scales et al. 2014). Overall, the physiochemical metrics for coastal habitat quality within the Project area are considered fair to good (USEPA 2015). This assessment considers different indices of biotic integrity for benthic organisms, fish, and physicochemical parameters such as dissolved oxygen, water clarity, chlorophyll a, nitrogen, phosphorous, and sediment contaminants and toxicity. Surface Water temperatures in the Project area range from approximately 39.0°F (3.9°C) to 69.6°F (20.9°C). The warmest temperatures occur from July through September and coldest temperatures occur from February through April. Surface waters experience the greatest temperature variation throughout the year while deeper waters maintain more consistent temperatures (COP Volume 2, SouthCoast Wind 2023).

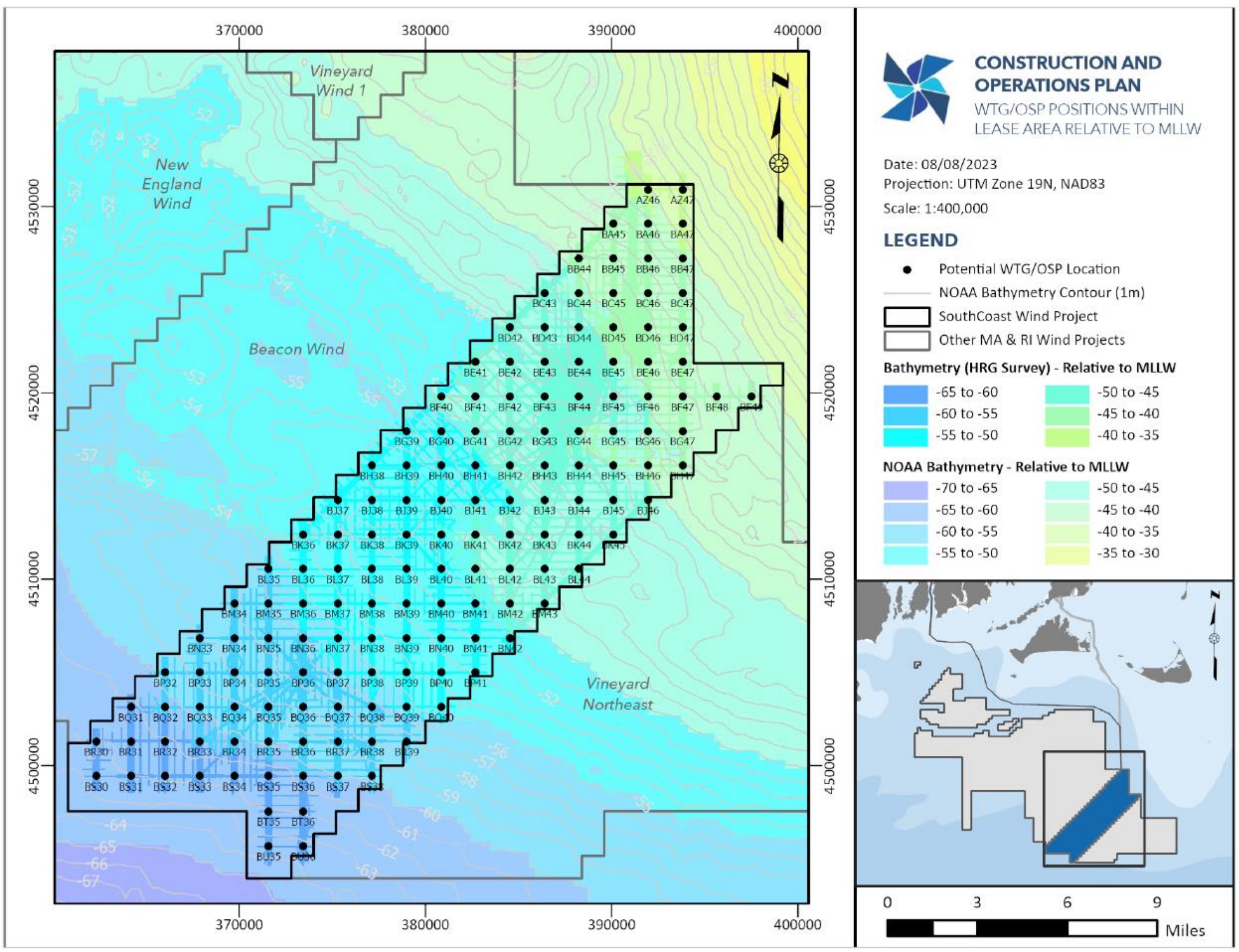


Figure 4.2-1. WTG/OSP positions in the Lease Area relative to MLLW

4.3 Water Quality

Surface waters in the Action Area include: (1) coastal onshore waterbodies that generally include freshwater ponds, streams, and rivers; and (2) coastal marine waters that generally include saline and tidal/estuarine waters, such as Nantucket Sound, Rhode Island Sound, Mount Hope Bay, Sakonnet River, and the Atlantic Ocean. Surface waters within most of the Action Area and all of the Onshore Project areas are coastal marine waters.

In federal waters, seasonal average turbidity ranges from 0.47 to 0.59 nephelometric turbidity units (NTU), seasonal average total nitrogen ranges from 10.1 to 11.7 micrometers (µm), seasonal average total phosphorus ranges from 0.61 to 0.76 µm, and seasonal average dissolved oxygen (DO) concentration ranges from 7.6 to 9.8 milligrams per liter (mg/L). Salinity averages remained fairly stable; ranging only from approximately 31.5 practical salinity units (psu) to 32.9 psu (CCS 2020).

In coastal waters near the Falmouth ECC, seasonal average turbidity ranges from 2.2 to 2.8 NTU, seasonal average total nitrogen ranges from 35.0 to 42.3 µm, seasonal average total phosphorus is 1.4 µm, and seasonal average DO concentration ranges from 6.7 to 7.2 mg/L. Salinity averages remained fairly stable; ranging only from 21.1 to 21.8 psu (CCS 2020). These water quality parameters were used to determine a Water Quality Index (WQI) for each sample characterized as Good, Fair, or Poor. In Nantucket Sound, 88 percent of the samples (seven of eight) received a WQI of Good and the remaining sample was Fair.

In coastal waters near the Brayton Point ECC by Gould Island, seasonal average turbidity ranges from 1.2 to 2.5 NTU, seasonal average total nitrogen ranges from 0.21 to 0.33 µm, seasonal average total phosphorus ranges from 0.04 to 0.08 µm, and seasonal average DO concentration ranges from 6.1 to 7.3 mg/L. Salinity averages range from approximately 28 psu to 30.3 psu (Appendix H, SouthCoast Wind 2023). The Sakonnet River is a tidal straight flowing from Mt. Hope Bay to Rhode Island Sound and located east of Narragansett Bay in Rhode Island. Physical and chemical data were collected from the Sakonnet River U.S. Geological Survey (USGS) Buoy monitoring station to characterize its water quality conditions in 2018 and 2019. The Sakonnet River remains saline throughout the year due to tidal influence. Reaching peak temperatures in the summer months, the river also reaches its lowest dissolved oxygen levels. Seasonal algal growth, seen as increased Chlorophyll a, as well as low dissolved oxygen levels have raised concern for the ecological health of the river (USGS 2019). The primary causes of the observed water quality impairments are the inputs of nutrients from wastewater management and stormwater runoff from the surrounding developed area (USGS 2019). The Sakonnet River is listed in the State of Rhode Island 2018-2020 Impaired Waters Report (RIDEM 2021). The waterbody is identified as Category 4A – Waterbodies for which a Total Maximum Daily Load (TMDL) has been developed. The TMDL for fecal coliform was published April 7, 2005 (RIDEM 2005). The TMDL indicates the impaired reach of the Sakonnet River includes “waters north of a line extending from the southwestern-most corner of the stone bridge in Tiverton to the eastern-most extension of Morningside Lane in Portsmouth.” The landfall for the offshore export cable on Aquidneck Island is within this reach. The 180-acre (73-hectare) area is closed to shell fishing due to the presence of fecal coliform.

In coastal waters near the Brayton Point ECC within Mount Hope Bay, seasonal average total nitrogen ranges from 0.12 to 0.18 mg/L, and seasonal average DO concentration ranges from 7.1 to 7.9 mg/L. Salinity averages range from approximately 27.2 psu to 27.9 psu (NBFSMN 2018). Other coastal waters near the Project area, including Buzzards Bay, Mount Hope Bay, Upper Narragansett, Providence River, Newport Harbor/Coddington Cove and associated tidal tributaries, are listed as 303(d) impaired. These waters are non-attaining for fish consumption, ecological or recreational use, with causes including metals other than Mercury, nutrients, oil and grease, trash, pathogens, total toxins, oxygen depletion, and PCBs (USEPA 2020).

4.4 Underwater Noise

The Lease Area is located in the continental shelf environment characterized by predominantly sandy seabed sediments. Kraus et al. (2016) recorded ambient noise in the Massachusetts and Rhode Island WEA from 2011 to 2015 and found sound levels in the 70.8 to 224 Hertz (Hz) frequency band with variations between 96 and 103 dB re 1 µPa (decibel referenced to 1 microPascal) during 50 percent of the recording time. Water depths in the Lease Area vary between 121 to 210 feet (37 to 64 meters). During the summer months (June-August), the average temperature of the upper 32.8 to 49.2 feet (10 to 15 meters) of the water column is higher, resulting in an increased surface layer sound speed. This creates a downward refracting environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy in the fall and winter months (September-February) results in a sound speed profile that is more uniform with depth. The shoulder months between summer and winter vary between the two. The sound speed at the surface is, on average, 4,954 feet per second (1,510 meters per second). At a depth of 197 feet (60 meters), the average sound speed is 4,872 feet per second (1485 meters per second) (COP Appendix U2; Figure E-3).

4.5 EMFs

The natural magnetic field in the Action Area has a total intensity of approximately 512 to 514 milligauss (mG) at the seabed, based on modeled magnetic field strength from 2019 through 2021 (NOAA 2021). The marine environment continuously generates additional ambient EMF. The motion of electrically conductive seawater through the Earth's magnetic field induces voltage potential, thereby creating electrical currents. Surface and internal waves, tides, and coastal ocean currents all create weak induced electrical and magnetic fields. Their magnitude at a given time and location is dependent on the strength of the prevailing magnetic field, site, and time-specific ocean conditions. Other external factors like electrical storms and solar events can also cause variability in the baseline level of EMF naturally present in the environment (CSA Ocean Sciences 2019).

Following the methods described by Slater et al. (2010), a uniform current of 1 meter per second (m/s) flowing at right angles to the natural magnetic field in the Action Area could induce a steady-state electrical field on the order of 51.5 microVolts per meter (µV/m). Wave action will also induce electrical and magnetic fields at the water surface on the order of 10 to 100 µV/m and 1 to 10 mG, respectively, depending on wave height, period, and other factors. While these effects dissipate with depth, wave action will likely produce detectable EMF effects up to 185 feet (56 meters) below the surface (Slater et al. 2010).

Several existing cables intersect the Falmouth ECC. Cables supplying power and communication from the mainland to Martha's Vineyard intersect the western edge of the surveyed ECC and the western alternative landfall approach to Falmouth. Crossing the Falmouth ECC just south of the entry to Muskeget Channel are three potential, out-of-service cables, of presently unknown origin. In the case of the Brayton Point ECC, a gas pipeline and two water pipelines cross the Sakonnet River, and therefore also the surveyed ECC. Three cables cross southern Mt. Hope Bay, close to and parallel with the Mt. Hope Bridge. Further details are provided in the Geohazard Report of each ECC in Appendix E of SouthCoast Wind's COP (SouthCoast Wind 2023). There are no permanent seabed installations, such as telecommunication or naval cables, in the offshore portion of the Project area, including the Lease Area.

Though no submarine transmission or communication cables have been identified in the Project area, these can also contribute to EMF levels in an area. Electrical telecommunications cables are likely to induce a weak EMF in the immediate area along the cable path. Gill et al. (2005) observed electrical fields on the order of 1 to 6.3 µV/m within 3.3 feet (1 meter) of a typical cable of this type. The heat effects of communication cables on surrounding sediments are likely to be negligible given the limited transmission power levels involved. Fiber-optic cables with optical repeaters would not produce EMF or significant heat effects.

4.6 Artificial Light

Vessel traffic and safety lighting on marine structures (i.e., buoys and meteorological towers) are the only sources of artificial light in the offshore portion of the Action Area. The construction and O&M of WTG and OSP structures would introduce new short-term and long-term sources of artificial light to the offshore environment in the forms of vessel lighting and navigation and safety lighting on offshore WTGs and OSP foundations. Maintenance vessel lighting and operational lighting on WTG and OSP foundations, in the forms of navigation, aircraft safety, and work lighting, would produce long-term lighting effects over the life of planned offshore wind projects. BOEM has issued guidance for avoiding and minimizing artificial lighting impacts from offshore energy facilities and associated construction vessels (BOEM 2021f; Orr et al. 2013) and has concluded that adherence to these measures should effectively avoid adverse effects on marine mammals, sea turtles, fish, and other marine organisms (Orr et al. 2013). BOEM would require all future offshore energy projects to comply with this guidance. Land-based artificial light sources are generally predominant in nearshore areas with substantial residential, commercial, and industrial shoreline development, such as at the Falmouth and Brayton Point landfall locations.

4.7 Vessel Traffic

There is wide variance in traffic density, vessel types, and vessel sizes within the Project area. To quantify these variables, SouthCoast Wind retained DNV Energy USA Inc. (DNV GL) to conduct an independent Navigation Safety Risk Assessment (NSRA) of the proposed SouthCoast Wind Project. The sources employed to identify vessel traffic patterns in the NSRA include Nationwide Automatic Identification System (AIS) data for 2019; 2016 vessel monitoring system data from NMFS; vessel trip report data from 2011 to 2015; the Massachusetts and Rhode Island Port Access Route Study (USCG 2020); and interactions with recreational boating, fishing, and towing industry organizations, agencies, and other stakeholders. The study area of the assessment consists of an area extending at least 20 nautical miles (37 kilometers) on all sides of the Project area (Figure 4.7-1). Based on the information in the NSRA, vessel traffic in the northern portion of the NSRA study area (within Nantucket Sound, the Sakonnet River, and Mount Hope Bay) comprises smaller vessels with a high seasonal activity. The vessel traffic in the southern portion of the study area—encompassing the Lease Area, other lease areas, Nantucket Shoals, and the Nantucket Ambrose Fairway—is more varied, with a mixture of deep draft vessels and commercial fishing vessels engaged in fishing or transiting to fishing grounds outside the Project area. The number of vessel tracks in the study area is highest in the summer with a peak in July of over 21,000 tracks. The low is in January with less than 3,500 tracks. In 2019, summer increases were greatest for pleasure, fishing, passenger, and other vessel types. For the southern portion of the study area, where the Lease Area is located, the vast majority of the seasonal increase is from fishing vessels in the summer. Non-fishing vessels show a seasonal effect, but to a much lower extent. Summer is the peak for passenger, pleasure, and tug/service vessels; fall is the peak for tankers with non-oil cargoes; and spring and fall are peaks for cargo/carrier and tanks with oil cargoes. The total AIS traffic density for 2019 is shown on Figure 4.7-2, and Table 4.7-1 shows the average vessel details from the study area assessment and the vessel tracks that intersect the Lease Area and offshore ECCs derived from the NSRA study area.

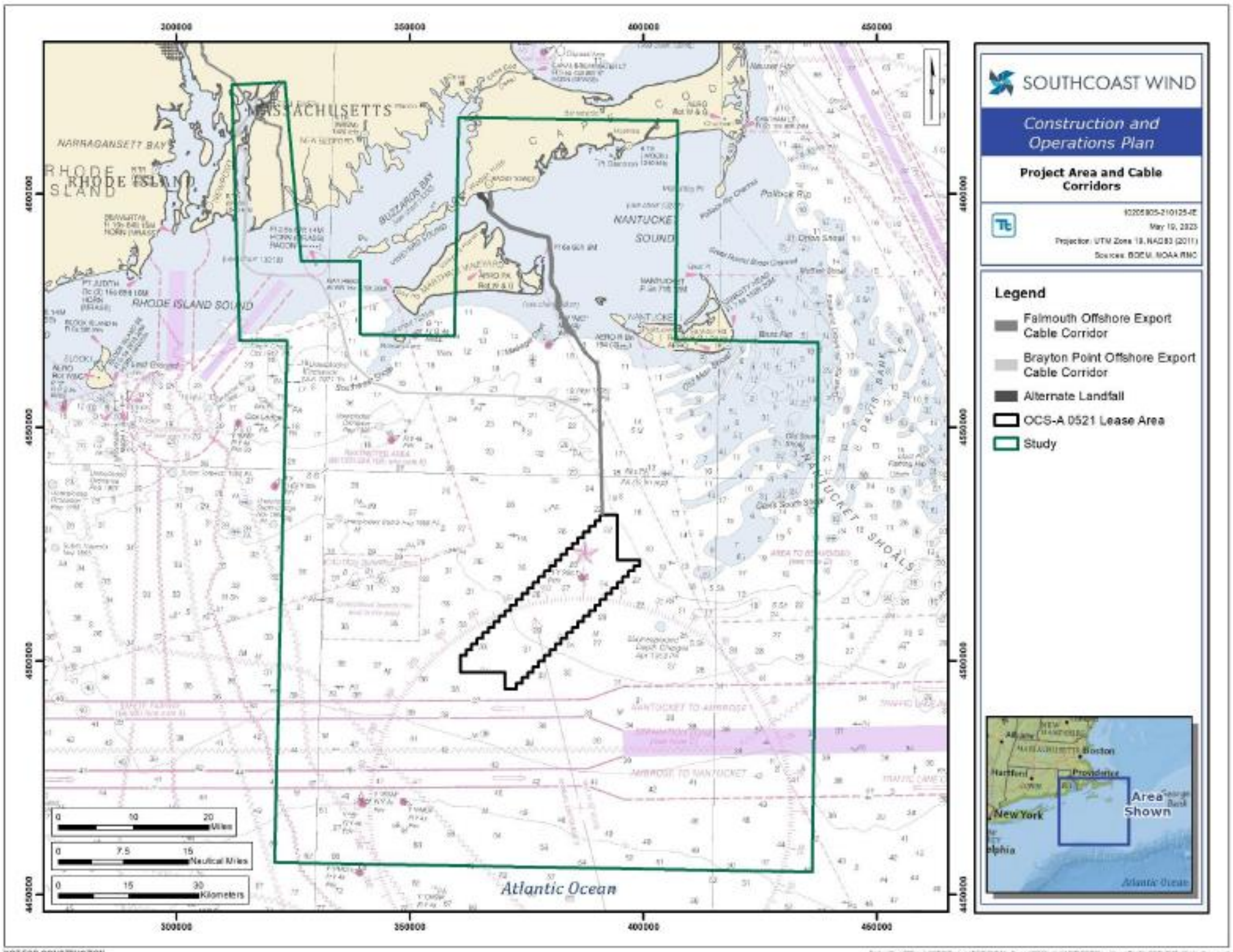


Figure 4.7-1. NSRA study area

Most cargo, carrier, and tanker vessel traffic near the study area use the Nantucket Ambrose Fairway and Narragansett Bay traffic separation schemes, located south and west of the Lease Area, respectively. The highest density of vessel traffic is within the Nantucket Ambrose Fairway, located between the approaches to New York and waters south of Nantucket, south of the Lease Area. Some deep draft vessels cross the Lease Area when transiting between the Nantucket Ambrose Fairway and the Narragansett Bay traffic separation scheme. Minimal cargo and tanker activity occurs within the Sakonnet River and Rhode Island Sound with slightly higher activity within Mount Hope Bay (COP Volume 2, Section 13.1.1; SouthCoast Wind 2023).

Within the study area, the area with the most commercial fishing vessel traffic is in the northwest-southeast corridor from Martha’s Vineyard and along Nantucket Shoals intersecting the Falmouth ECC. Near the Brayton Point ECC, the most commercial fishing activity occurs in Rhode Island Sound with limited activity within Mount Hope Bay and the Sakonnet River, with the exception of high levels of monkfish fishing and limited gillnet fishing (COP Volume 2, Section 13.1.1; SouthCoast Wind 2023).

Most passenger vessels present in the study area occur in the area between Cape Cod, Martha’s Vineyard, and Nantucket. There are also cruise ships that transit the Nantucket Ambrose Fairway, and some pleasure vessel transits within Nantucket Sound and Rhode Island Sound, the Sakonnet River, and Mount Hope Bay (COP Volume 2, Section 13.1.1; SouthCoast Wind 2023).

Size distributions for length overall (LOA), beam, and dead weight tonnage (DWT) for vessels in the NRSA study area (Table 4.7-1) are based on unadjusted AIS data. The average cargo/carrier vessel is 823 feet (251 meters) LOA. Oil tankers and other tankers average 633 feet (193 meters) and 564 feet (172 meters) LOA, respectively. Fishing, pleasure and tugs all average less than 82 feet (25 meters) LOA. Beam and DWT show similar patterns.

Vessel sizes and even some vessel types were present only in the northern or southern portion of the study area. Cargo and carrier vessels transited both in the north and south study areas, but no cargo/carrier vessel tracks crossed from one area into the other. Cargo/carrier vessels in the North study area had an average LOA of 295 feet (90 meters), while vessels in the southern portion of the study area were more than twice as large, averaging 827 feet (252 meters) LOA primarily because of the Nantucket Ambrose Fairway south of the Lease Area. Fishing, other, pleasure vessels, and tugs transited in and between the northern and southern study areas and had fairly consistent LOA across the study area.

There were no tanker tracks in the northern portion of the study area. Passenger vessels in the southern portion of the study area were nearly four times as long as their counterparts in the northern portion of the study area. This is because the ferries crossing Nantucket Sound and the cruise ships transiting in the Nantucket Ambrose Fairway are both categorized as passenger vessels.

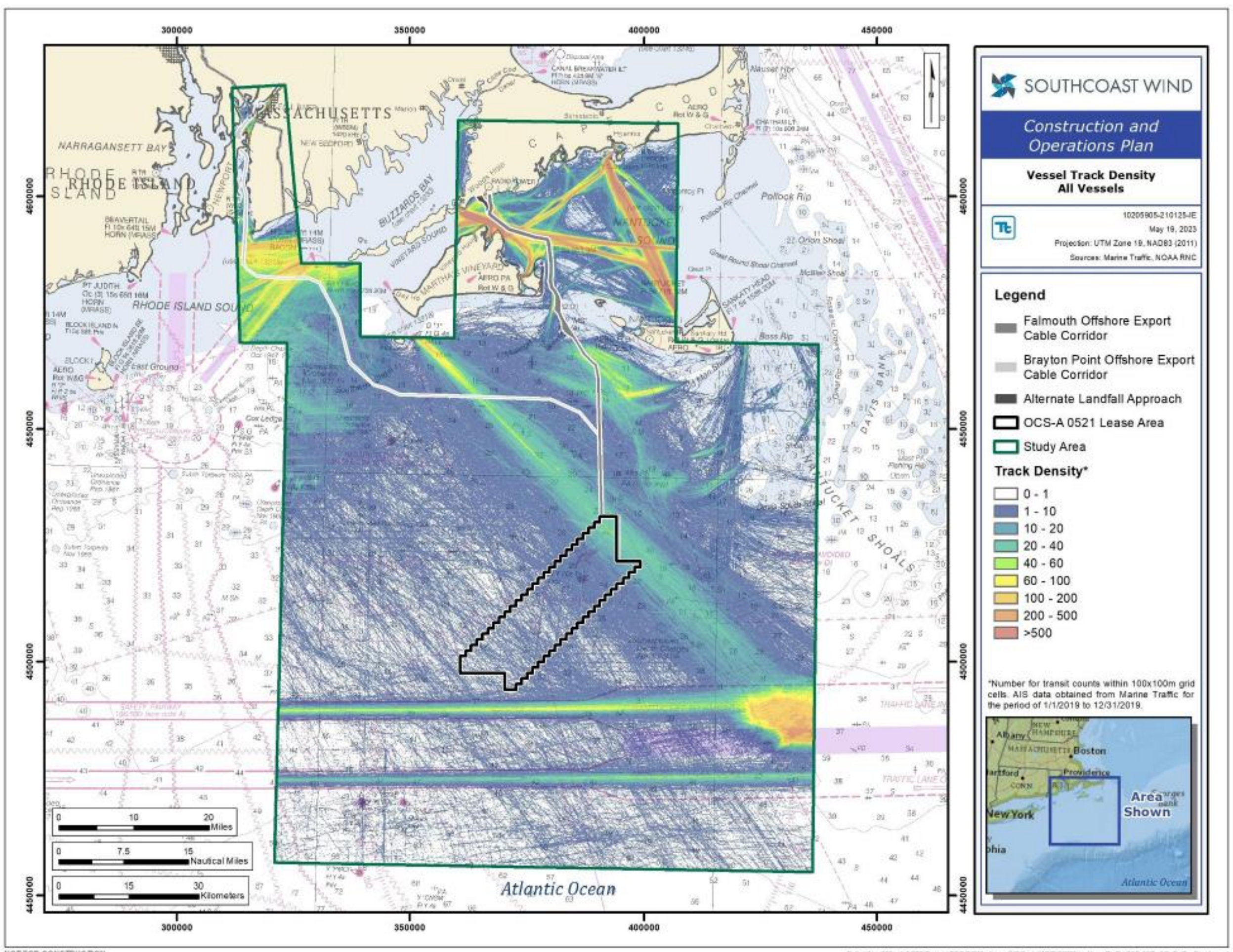


Figure 4.7-2. AIS traffic density in the NRSA study area (January to December 2019)

Table 4.7-1. Vessel details in the NSRA study area and vessel tracks that intersect the Project area (January 1 to December 31, 2019)

Vessel Type	Draft	Average Speed	Average DWT	Average Beam (meters)	Average LOA (meters)	Vessel Tracks	Percent of Total
Cargo	Deep	13.7	59,862	35	251	163	1%
Fishing[1]	Shallow	4.7	N/A	7	25	11,303	38%
Passenger	Shallow	15.0	731	14	64	2,803	9%
Pleasure Craft/ Sailing[2]	Shallow	10.4	167	5	18	11,251	38%
Tanker	Shallow	11.8	36,919	28	172	180	1%
Tug/Tow	Shallow	4.9	522	6	19	1,708	6%
Other/Not Available[2]	Shallow	4.1	495	11	46	2,326	8%
Total						**29,734**	**100%**

Source: Office for Coastal Management 2022.
DWT = dead weight tonnage; LOA = length overall
[1] AIS track counts for fishing and pleasure vessels underrepresent these vessel types, as not all of these vessel types are required to have AIS on board per USCG regulations.
[2] Other/Not Available vessel types include research, military, law enforcement, and unspecified vessels.

4.8 Description of Critical Habitat in the Action Area

There is no critical habitat designated for any ESA-listed species within the Project area. However, designated critical habitats are found within the larger Action Area that includes potential vessel routes to and from ports along the East Coast, the Gulf of Mexico, Canada, and other international ports. Critical habitats for the Chesapeake Bay and Carolina (DPSs) of Atlantic sturgeon, the North Atlantic right whale (NARW, *Eubalaena glacialis*), the Northwest Atlantic Ocean DPS of loggerhead sea turtle (*Caretta caretta*), Nassau grouper (*Epinephelus striatus*), and fish (Gulf sturgeon *[Acipenser oxyrinchus desotoi]*, smalltooth sawfish *[Pristis pectinata]* and coral (Elkhorn coral *[Acropora palmata]*, staghorn coral *[Acropora cervicornis]* species in the Gulf of Mexico occur in the Action Area. These critical habitats have the potential to be affected only by interactions with vessels outside of the offshore wind farm, offshore export cable system, and supporting ports for the proposed Project. Primarily, these interactions may be associated with transits of vessels and the transport of components during construction of the Project. As described in Sections 4.8.1 through 4.8.6, vessel traffic is not expected to affect any physical and biological features (PBFs) of critical habitat designated in the Action Area and would, therefore, have **no effect** on the designated critical habitat for these species. Based on the rationale provided in the following sections, the critical habitats outlined below are discounted from further analysis in this BA.

4.8.1 Critical Habitat for North Atlantic Right Whale

NMFS designated critical habitat for the NARW on January 27, 2016 (NMFS 2016a). This designation included two units: a foraging area in the Gulf of Maine and Georges Bank region (Unit 1) and a calving area off the southeastern coast of the U.S. (Unit 2) (Figure 4.8-1). The Project area does not directly overlap designated NARW critical habitat, but both Unit 1 and Unit 2 regions fall within the larger Action Area. In addition, the Project is adjacent to and slightly overlaps the Nantucket Shoals. Nantucket Shoals is not designated as critical habitat for any ESA species but it is still an important area for NARW feeding given its unique oceanographic and bathymetric features that allow for year-round high phytoplankton biomass, likely contributing to increased availability of zooplankton prey for NARWs (Quintana-Rizzo et al. 2021). It is also important to note that climate change has affected the abundance and distribution of the NARW's primary prey species (Record et al. 2019). Recent analyses (O'Brien et al. 2022a) indicate that NARW habitat use has recently increased in Southern New England as a result of either changes in prey distribution within Southern New England, or a decline in prey in other areas abandoned by NARW. This climate-driven repatriation of feeding habitats could potentially extend the NARW's habitat-use patterns beyond Nantucket Shoals and into Southern New England WEAs.

The northeast NARW critical habitat area (Unit 1) is located to the north and west of the Project area and is included in the Action Area. Unit 1 is an important area for NARW foraging because of the prevalence of the copepod, *Calanus finmarchicus*. Given a NARW's size in relation to its prey, high densities of copepods are required to meet a NARW's energetic demands. The PBFs of foraging habitat (Unit 1) that contribute to these high-density copepod areas, which are essential to conservation of the species include:

- The physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate the *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.

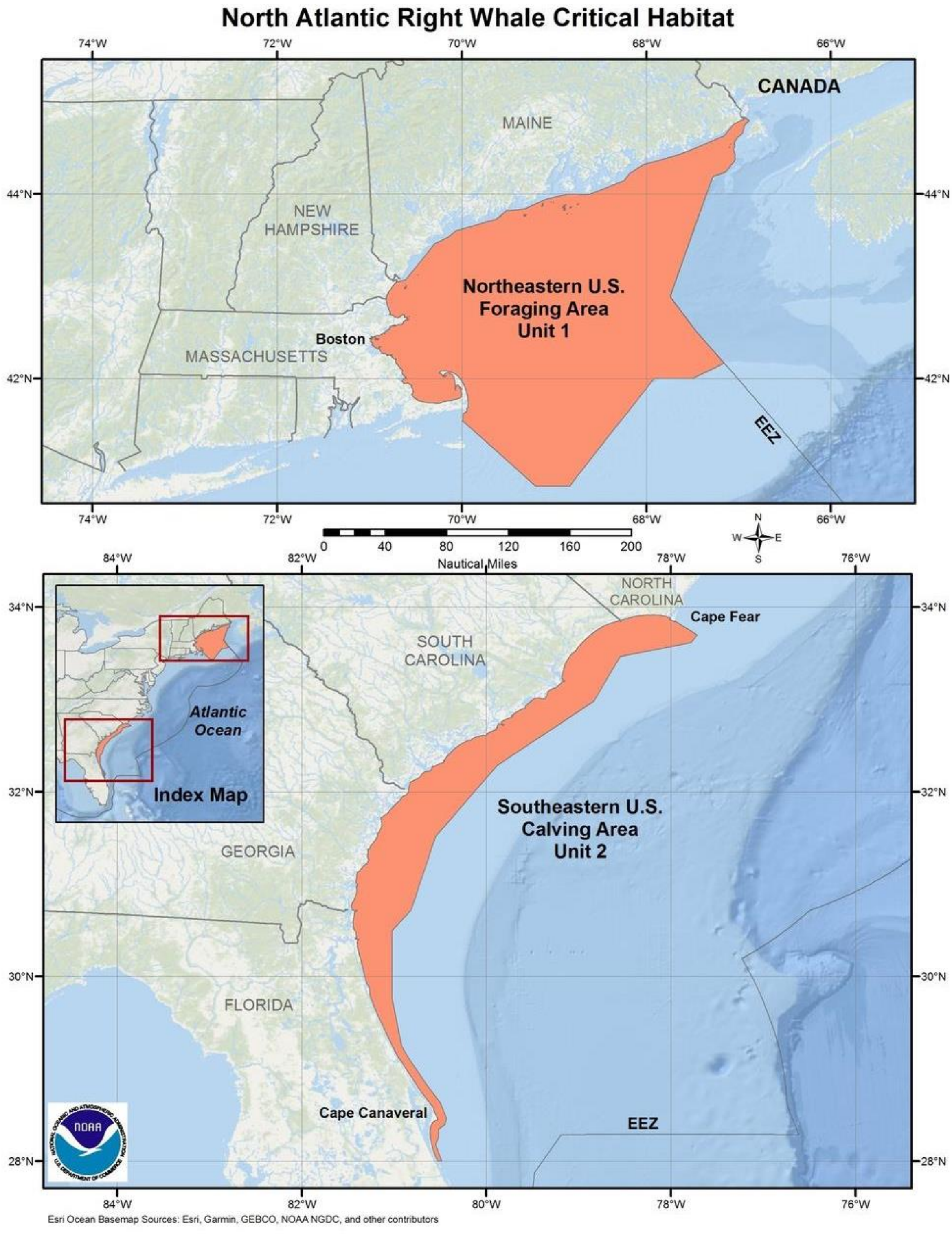
The physical oceanographic conditions, late stage *C. finmarchicus* aggregations, and aggregations of diapausing *C. finmarchicus* that have been identified as essential features are dynamically distributed throughout this specific area. The specific area includes the large embayments of Cape Cod Bay and Massachusetts Bay and deep underwater basins. The area incorporates state waters from Maine through Massachusetts as well as federal waters, but does not include inshore areas, bays, harbors, and inlets (NOAA 2015).

The southeast NARW critical habitat area (Unit 2) is located offshore of the southern U.S. The portion of the Action Area that includes potential vessel routes to and from South Carolina and ports in the Gulf of Mexico may overlap Unit 2, which includes waters off the coasts of North Carolina, South Carolina, Georgia, and the Atlantic coast of Florida.

The PBFs of calving habitat essential to conservation of the species include:

- Calm sea surface conditions (below 5 on the Beaufort Wind Scale),
- Sea surface temperatures of 44.6 to 62.6°F (7 to 17°C), and
- Water depths of 19.7 to 26.2 feet (6 to 8 meters).

Vessel traffic through either the Unit 1 or Unit 2 portions of the Action Area would not affect any of their essential PBFs. Occasional vessel traffic will have no effect on the established oceanographic conditions in Unit 1 that concentrate copepod prey for foraging or on the sea state conditions in Unit 2 that provide appropriate calving habitat, nor on NARW selection of these areas for foraging or calving. As a precaution, and required by federal regulations, all vessels must maintain a distance of 1,640 feet (500 m) or greater from any sighted NARW. Compliance with this regulation aids in ensuring no adverse effects on the ability of whales to select an area with the co-occurrence of these features. In addition, Project vessels transiting along the Atlantic coast between North Carolina and Florida could use routes located offshore of the designated critical habitat and would not need to travel through that area. Therefore, the Proposed Action would not affect designated critical habitat (Unit 1 or Unit 2) for NARW and is discounted from further evaluation in this BA.



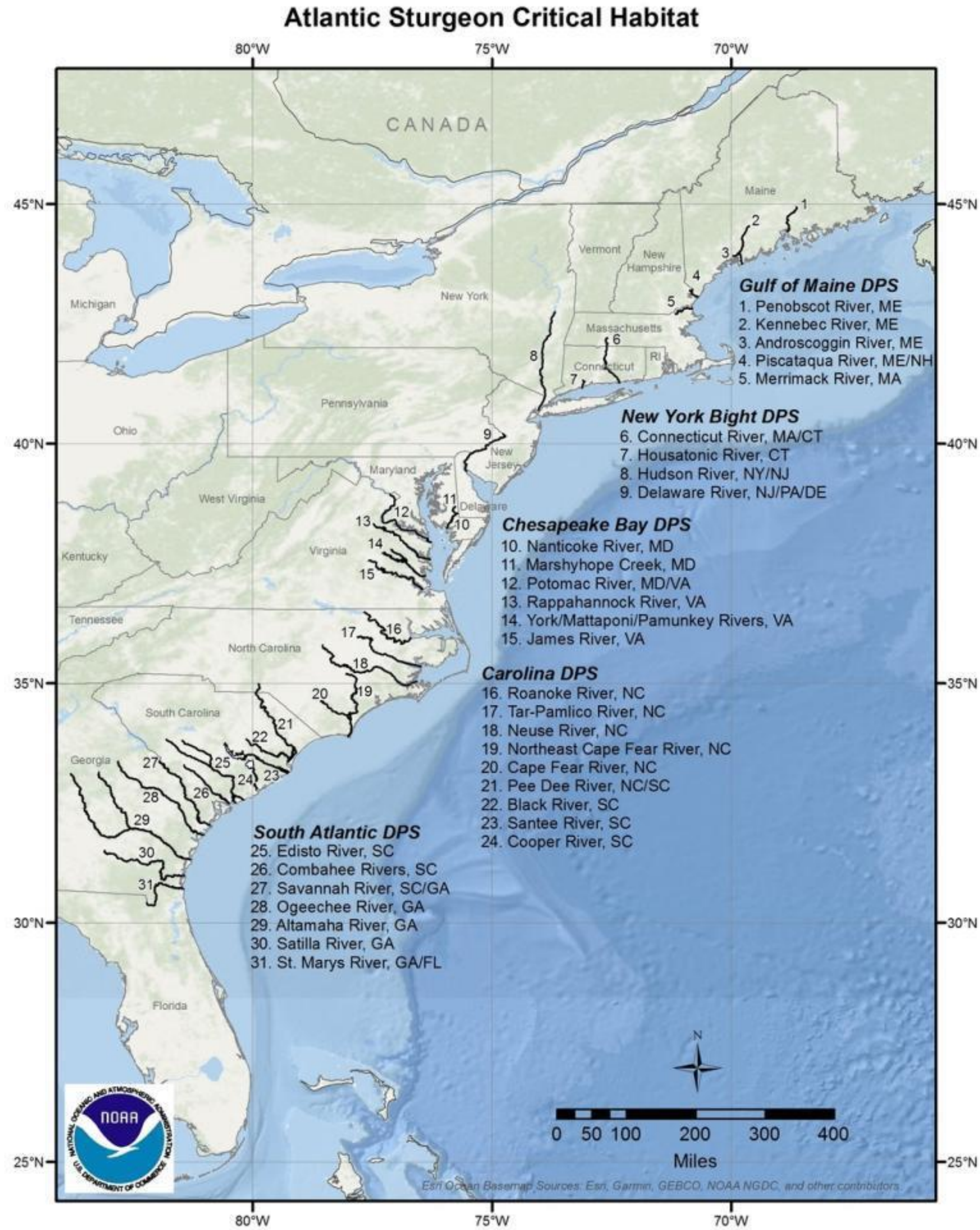
Source: NMFS 2023h

Figure 4.8-1. North Atlantic right whale critical habitat (Unit 1 and 2) in the Action Area

4.8.2 Critical Habitat for all Listed DPSs of Atlantic Sturgeon

The final rule for Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) critical habitat (all listed DPSs) was issued on August 17, 2017 (82 FR 39160). This rule includes 31 units, all rivers, occurring from Maine to Florida (NMFS 2017a; NMFS 2017b). Subsequently, critical habitat was designated for each DPS (Figure 4.8-2). No marine habitats were identified as critical habitat because the physical and biological features in these habitats essential for the conservation of Atlantic sturgeon could not be identified.

Critical habitat designations for the Gulf of Maine DPS of Atlantic sturgeon encompass approximately 244 kilometers (km; 152 miles) of aquatic habitat in the following rivers of Maine, New Hampshire, and Massachusetts: Penobscot, Kennebec, Androscoggin, Piscataqua, Cocheco, Salmon Falls, and Merrimack. Critical habitat designations for the New York Bight DPS of Atlantic sturgeon contain approximately 547 km (340 miles) of aquatic habitat in the following rivers of Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, and Delaware: Connecticut, Housatonic, Hudson, and Delaware. Critical habitat designations for the Chesapeake Bay DPS of Atlantic sturgeon contain approximately 773 km (480 miles) of aquatic habitat in the following rivers of Maryland, Virginia, and the District of Columbia: Potomac, Rappahannock, York, Pamunkey, Mattaponi, James, and Nanticoke (including Marshyhope Creek). Critical habitat designations for the Carolina DPS of Atlantic sturgeon contain approximately 1,939 km (1,205 miles) of aquatic habitat in the following rivers of North Carolina and South Carolina: Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee (including Bull Creek), Black, Santee, North Santee, South Santee, and Cooper. Critical habitat designations for the South Atlantic DPS of Atlantic sturgeon contain approximately 2,883 km (1,791 miles) of aquatic habitat in the following rivers of South Carolina, Georgia, and Florida: Edisto, Combahee-Salkehatchie, Savannah, Ogeechee, Altamaha, Ocmulgee, Oconee, Satilla, and St. Marys Rivers.



Source: NMFS 2023j

Figure 4.8-2. Critical Habitat for Atlantic Sturgeon

The Project area is a significant distance from the tributaries included in Atlantic sturgeon critical habitat, and no construction, O&M, or decommissioning activities would occur within or adjacent to tributaries in these areas. The only Project activity that may affect Atlantic sturgeon critical habitat are Project vessel transits within the Action Area. Project vessel transits throughout the Action Area do not include the rivers identified for the Gulf of Maine, New York Bight, or South Atlantic DPS critical habitats and are not discussed further.

Project vessels have the potential to transit through or near critical habitat for the Chesapeake Bay and Carolina Distinct Population Segments (DPSs) of Atlantic sturgeon. The following PBFs are essential to the conservation of the species and may require special management considerations or protection (82 FR 39160):

- Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder) in low salinity waters (i.e., 0.0–0.5 parts per thousand range) for settlement of fertilized eggs, refuge, growth, and development of early life stages.
- Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 parts per thousand and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development.
- Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear) between the river mouth and spawning sites necessary to support: (1) unimpeded movements of adults to and from spawning sites; (2) seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and (3) 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 3.9 feet [1.2 meters]) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.
- 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: (1) spawning; (2) annual and interannual adult, subadult, larval, and juvenile survival; and (3) larval, juvenile, and subadult growth, development, and recruitment (e.g., 55.4°F to 78.8°F [13°C to 26°C] for spawning habitat and no more than 86°F [30°C] for juvenile rearing habitat, and 6 mg/L or greater dissolved oxygen for juvenile rearing habitat).

In addition to the first three PBFs given above, the critical habitat for the Atlantic Sturgeon Carolina DPS also includes:

- Water quality conditions, especially in the bottom meter of the water column, between the river mouths and spawning sites with temperature and oxygen values that support: (1) spawning; (2) annual and inter-annual adult, subadult, larval, and juvenile survival; and (3) larval, juvenile, and subadult growth, development, and recruitment. Appropriate temperature and oxygen values will vary interdependently and depending on salinity in a particular habitat. For example, 6.0 mg/L dissolved oxygen or greater likely supports juvenile rearing habitat, whereas dissolved oxygen less than 5.0 mg/L for longer than 30 days is less likely to support rearing when water temperature is greater than 25°C. In temperatures greater than 26°C, dissolved oxygen greater than 4.3 mg/L is needed to protect survival and growth. Temperatures 13°C to 26°C (55.4°F to 78.8°F) likely support spawning habitat.

Vessel traffic and associated impacts from vessels, such as vessel strikes, noise, and accidental spills/releases, could potentially impact critical habitat for the Chesapeake Bay and Carolina DPSs. Potential Project ports that overlap these critical habitats are the Port of Charleston in South Carolina, which is located near the mouth of the Cooper River and Sparrows Point Port in Maryland, which is upstream of all the critical habitat for the Chesapeake Bay DPS.

The Port of Charleston and Sparrows Point Port both have a low likelihood of being used (Table 3.1-14) with only eight trips at each of these ports planned for the entire construction phase and only two trips planned for the entirety of the O&M phase. Therefore, the Proposed Action would not have an impact on any relevant PBFs of the designated critical habitat of the Chesapeake Bay DPS and Carolina DPS of Atlantic sturgeon, thus, these critical habitats are discounted from further evaluation in this BA.

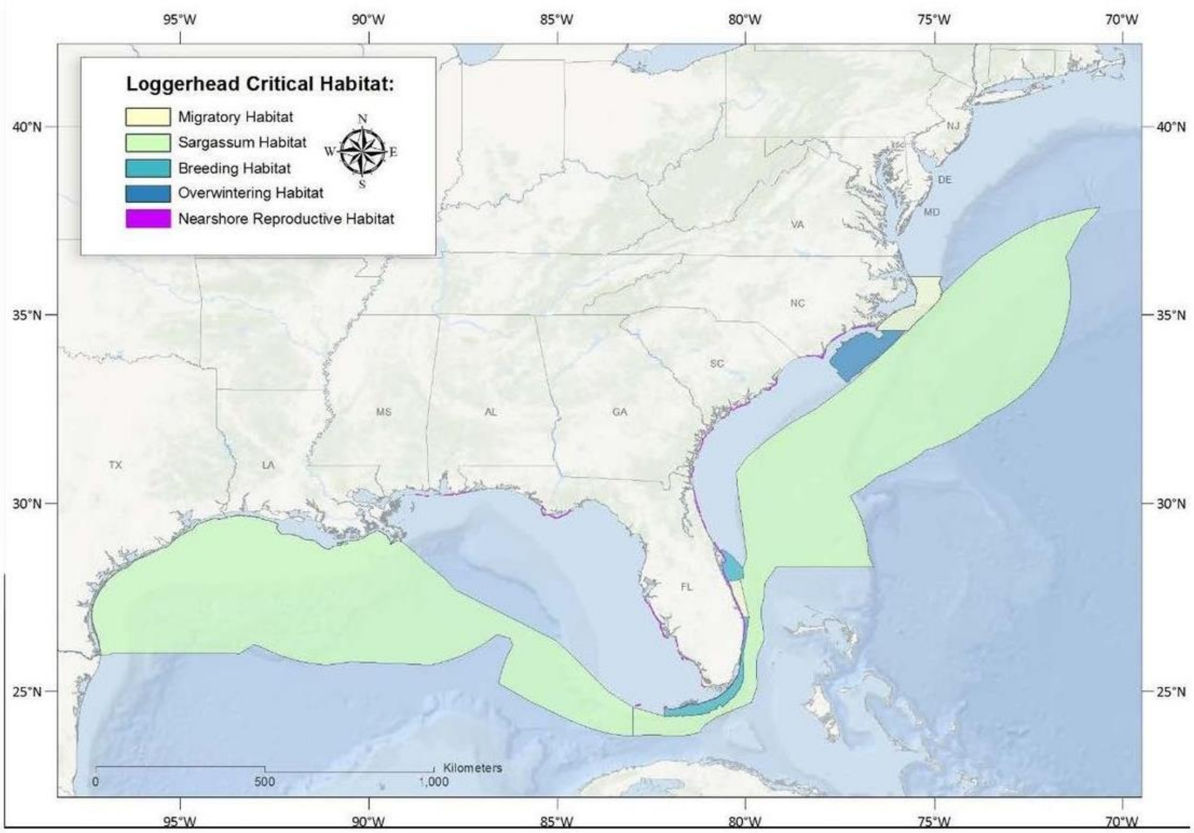
4.8.3 Critical Habitat for the Northwest Atlantic Ocean DPS of Loggerhead Sea Turtle

NMFS designated critical habitat for the Northwest Atlantic Ocean DPS of the loggerhead sea turtle on August 11, 2014 (NMFS 2014a). This designation included nearshore reproductive habitat, wintering habitat, breeding habitat, constricted migratory corridors, and/or *Sargassum* habitat in the Atlantic Ocean and Gulf of Mexico (Figure 4.8-3). Vessels transiting routes to and from the ports in South Carolina and the Gulf of Mexico may travel through wintering habitat, breeding habitat, migratory habitat, and/or *Sargassum* habitat.

Wintering habitat is defined as "warm water habitat south of Cape Hatteras, North Carolina near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months." Breeding habitat is defined as "sites with high densities of both male and female adult individuals during the breeding season." Constricted migratory habitat is defined as "high use migratory corridors that are constricted… by land on one side and the edge of the continental shelf and Gulf Stream on the other side." *Sargassum* habitat is defined as "developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material." PBFs for these habitats include:

- Specific water temperatures: greater than 50°F (10°C) from November through April for winter habitat; suitable for optimum *Sargassum* growth for *Sargassum* habitat;
- Specific water depths: 65.5 to 328 feet (20 to 100 meters) for winter habitat, greater than 32.8 feet (10 meters) for *Sargassum* habitat;
- Specific geographic locations: continental shelf waters in proximity to the western boundary of the Gulf Stream for winter habitat, proximity to primary Florida migratory corridor and Florida nesting grounds for breeding habitat, constricted shelf area that concentrates migratory pathways for migratory habitat, proximity to currents for offshore transport for *Sargassum* habitat;
- High densities of males and female turtles (breeding habitat);
- Passage conditions suitable for migration (migratory habitat);
- Convergence zones, downwelling areas, and/or boundary current margins that concentrate floating material (*Sargassum* habitat);
- *Sargassum* concentrations that support adequate cover and prey abundance (Sargassum habitat); and
- Prey availability (*Sargassum* habitat).

All Northwest Atlantic loggerhead critical habitat areas are outside of the Project area, but vessel transits from non-local ports through designated areas may occur. However, vessel transits through loggerhead critical habitat due to the Proposed Action will not affect the physical oceanographic conditions or modify the oceanographic features associated with growth, migratory, and wintering area functions. No effects of the Proposed Action were identified to foraging habitat, the seafloor, or prey items. Further, no effects to sufficient prey availability or prey quality were identified because of the Proposed Action. Vessel transits due to the Proposed Action would not decrease water temperatures below 50°F (10°C) from November through April, alter habitat in continental shelf waters near the western boundary of the Gulf Stream, or change water depths between 65.5 and 328 feet (20 and 100 m). Though the vessel traffic component of the Action Area may overlap with the designated areas mentioned previously, the physical and oceanographic features of the habitat would not be affected in a manner that adversely impacts the critical habitat. Since Project activities would not affect any of these essential PBFs, the Proposed Action would not affect designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtle, and this critical habitat is discounted from further evaluation in this BA.



Source: NMFS 2023i

Figure 4.8-3. Critical Habitat for the Northwest Atlantic Distinct Population Segment of Loggerhead Sea Turtles

4.8.4 Critical Habitat for Fish in the Gulf of Mexico

Critical habitat for fish species within the U.S. Gulf of Mexico includes: (1) Gulf sturgeon (*Acipenser oxyrinchus desotoi*) critical habitat (68 FR 13370) which comprises 14 geographic areas including freshwater rivers and tributaries and nearshore marine and estuarine habitats between the mouth of the Mississippi to the Suwannee River in Florida; and (2) smalltooth sawfish (*Pristis pectinata*) critical habitat designated in two coastal areas of south Florida in the Charlotte Harbor Estuary and the Ten Thousand Islands/Everglades (74 FR 45353). The only potential Project activities that would occur in the Gulf of Mexico would be vessel transits limited to smaller support vessels and only a minimal number of transits would be expected to occur throughout the life of the Project (Section 3.1.2.6). Additionally, no anchoring or other activities that could disturb the seafloor are likely to occur in the Gulf of Mexico, and no activities would occur that would disturb any essential physical or biological features within the designated critical habitats. Therefore, the potential for adverse effects from the Proposed Action to this critical habitat is discounted from further evaluation in this BA.

4.8.5 Critical Habitat for Nassau Grouper

Critical habitat for Nassau grouper (*Epinephelus striatus*) was designated in January 2, 2024 and becomes effective in February 1, 2024 (89 FR 126). The designated areas include habitat features that are essential to the conservation of Nassau grouper, including areas for spawning, recruitment, and development. The final designation includes 20 different geographic units and contain approximately 920.73 square miles (2,385.67 square kilometers) of aquatic habitat located in waters off the coasts of southeastern Florida and the Florida Keys, Puerto Rico, Navassa, and the U.S. Virgin Islands.

Within the habitats used by Nassau grouper as they progress through their life history stages, the following essential features have been identified (NMFS, 2023q):

- Recruitment and developmental habitat: Areas from nearshore to offshore necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey, consisting of the following:
- Nearshore shallow subtidal marine nursery areas with substrate that consists of unconsolidated calcareous medium to very coarse sediments (not fine sand) and shell and coral fragments and may also include cobble, boulders, whole corals and shells, or rubble mounds, to support larval settlement and provide shelter from predators during growth and habitat for prey.
- Intermediate hardbottom and seagrass areas in close proximity to the nearshore shallow subtidal marine nursery areas that provide refuge and prey resources for juvenile fish. The areas include seagrass interspersed with areas of rubble, boulders, shell fragments, or other forms of cover; inshore patch and fore reefs that provide crevices and holes; or substrates interspersed with scattered sponges, octocorals, rock and macroalgal patches, or stony corals.
- Offshore linear and patch reefs in close proximity to intermediate hardbottom and seagrass areas that contain multiple benthic types; for example: coral reef, colonized hardbottom, sponge habitat, coral rubble, rocky outcrops, or ledges, to provide shelter from predation during maturation and habitat for prey.
- Structures between the subtidal nearshore area and the intermediate hardbottom and seagrass area and the offshore reef area including overhangs, crevices, depressions, blowout ledges, holes, and other types of formations of varying sizes and complexity to support juveniles and adults as movement corridors that include temporary refuge that reduces predation risk as Nassau grouper move from nearshore to offshore habitats.

- Spawning Habitat: Marine sites used for spawning and adjacent waters that support movement and staging associated with spawning.

The only potential Project activities that might occur in Nassau grouper critical habitat would be vessel transits from the Panama Canal through the Caribbean Sea and Southeast U.S. waters. Such vessel transits are estimated at fewer than ten trips over the entire life of the Project (Section 3.1.2.6). Most Nassau grouper critical habitat is designated in nearshore waters that are unlikely to be frequented by Project vessels. Additionally, no activities would occur that would disturb any essential physical or biological features within the designated critical habitats. Therefore, the potential for adverse effects from the Proposed Action is discounted from further evaluation in this BA.

4.8.6 Critical Habitat for Elkhorn and Staghorn Corals in the Gulf of Mexico

Critical habitats have been designated for elkhorn (*Acropora palmata)* and staghorn *(Acropora cervicornis)* corals on November 26, 2008 (NMFS 2008), including four specific areas: the Florida area, the Puerto Rico area, the St. John/St. Thomas area, and the St. Croix area. The Florida area encompasses approximately 1,329 square miles (3,442 square kilometers) of marine habitat. The portion of the Action Area associated with vessel transits to and from the Gulf of Mexico overlaps the Florida area (Figure 4.8-4). The physical and biological feature (PBF) essential to conservation of these species is substrate of suitable quality and availability (i.e., natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover) to support successful larval settlement and recruitment, and reattachment and recruitment of fragments.

The only potential Project activities that would occur in the Gulf of Mexico would be vessel transits, and only a minimal number of transits would be expected to occur throughout the life of the Project (Section 3.1.2.6). Further, vessel traffic would not affect this PBF as no substrate-disturbing activities (e.g., anchoring) are expected in this portion of the Action Area. Additionally, vessels transiting to and from Corpus Christi, Texas are expected to follow general traffic patterns through the Straits of Florida and across the Gulf of Mexico, which would not take them through the critical habitat for elkhorn and staghorn corals. Given the lack of vessel impacts on the PBF identified for conservation of elkhorn and staghorn corals, the Proposed Action is expected to have **no effect** on designated habitat for these species, and this critical habitat is excluded from further evaluation in this BA.

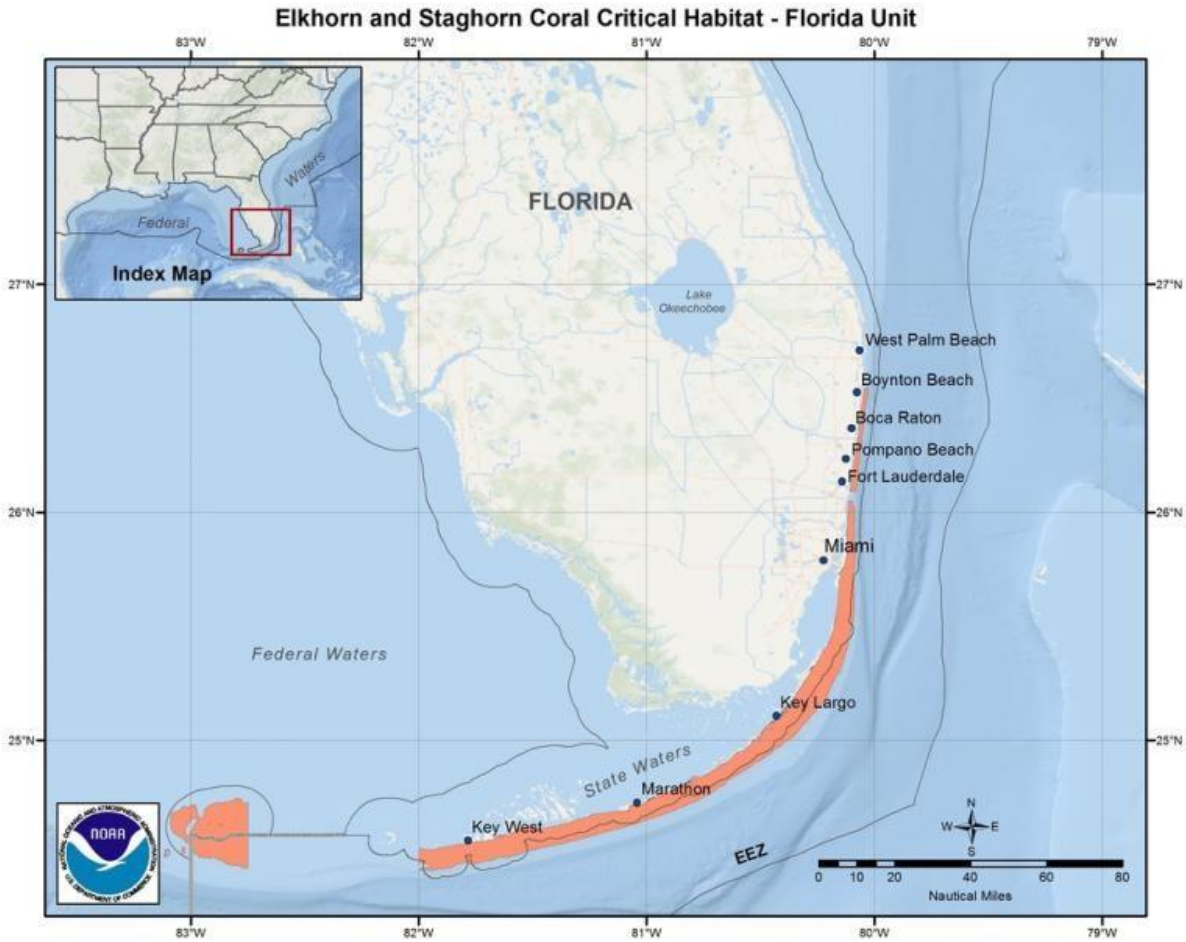


Figure 4.8-4. Critical Habitat for Elkhorn and Staghorn Coral in the Action Area

4.9 Description of ESA-listed Species in the Action Area

The best available information on the occurrence and distribution of ESA-listed species in the Action Area is provided by a combination of visual sighting, acoustic, stranding, bycatch, and fisheries survey data, including:

- Site-specific monthly aerial survey data collected by SouthCoast Wind (SouthCoast Wind 2023).
- Protected Species Observer data collected in the Project area (SouthCoast Wind 2023).
- Regional aerial survey data (New England Aquarium 2020a–2020m; O'Brien et al. 2021, 2022; Kraus et al. 2016).
- Sighting data retrieved from the Marine Life Data and Analysis Team (Curtice et al. 2019; Roberts 2018).
- Data from NOAA's Atlantic Marine Assessment Program for Protected Species surveys (NEFSC and SEFSC, 2011–2018).
- Fisheries data collected by federal and state agencies, including BOEM (Guida et al. 2017), the Northeast Fisheries Science Center the Northeast Area Monitoring and Assessment Program, Southeast Fisheries Science Center, Rhode Island Department of Environmental Management, and Massachusetts Division of Marine Fisheries.
- Other regional data (Kenney and Vigness-Raposa 2010; LaBrecque et al. 2015; New England Aquarium 2020a–2020m; Palka et al. 2017; Stone et al. 2017).

Based on this information, 28 ESA-listed species may occur in the Action Area (Table 4.9-1): seven marine mammal species, five sea turtle species, nine fish species, and seven coral species. The West Indian manatee (*Trichechus manatus*) is under the jurisdiction of the USFWS and will therefore not be addressed in this BA. Several species that could occur in the Action Area are either unlikely to occur or the occurrence would be limited to a portion of the Action Area outside of the impact area of most Project activities. For species unlikely to occur, the potential for adverse effects is discountable. For these species, potential effects of the Proposed Action are limited to interactions with vessels outside the Project area. Brief descriptions of each of these species are provided in Section 4.9.1. Species that are likely to occur in the Action Area and have greater potential for interactions are discussed in more detail in Sections 4.9.2.1, 4.9.2.2, and 4.9.2.3 for marine mammals, sea turtles, and fish, respectively.

Table 4.9-1. ESA-listed species in the Action Area

Species	District Population Segment	ESA Status		Critical Habitat Status	Critical Habitat Occurrence in Action Area
		Status	Listing Date		
Marine Mammals					
Blue whale	N/A	Endangered	1970	Not designated	N/A
Fin whale	N/A	Endangered	1970	Not designated	N/A
Humpback whale	Cape Verde/NW Africa DPS	Endangered	1970	Not designated	N/A
North Atlantic right whale	N/A	Endangered	1970	Designated	Yes
Rice's whale	N/A	Endangered	2019	Proposed	N/A

Species	District Population Segment	ESA Status		Critical Habitat Status	Critical Habitat Occurrence in Action Area
		Status	Listing Date		
Sei whale	N/A	Endangered	1970	Not designated	N/A
Sperm whale	N/A	Endangered	1970	Not designated	N/A
Sea Turtles					
Green sea turtle	North Atlantic	Threatened	2016	Designated	No
Hawksbill sea turtle	N/A	Endangered	1970	Designated	No
Kemp's ridley sea turtle	N/A	Endangered	1970	Not Designated	N/A
Leatherback sea turtle	N/A	Endangered	1970	Designated	No
Loggerhead sea turtle	Northwest Atlantic Ocean	Threatened	2011	Designated	Yes
Fish					
Atlantic Salmon	Gulf of Maine	Endangered	2009	Designated	No
Atlantic sturgeon	All DPSs	Threatened, Endangered	2012	Designated	Yes
Giant manta ray	N/A	Threatened	2018	Not designated	N/A
Gulf sturgeon	N/A	Threatened	1991	Designated	No
Nassau grouper	N/A	Threatened	2016	Designated	Yes
Oceanic whitetip shark	N/A	Threatened	2018	Not designated	N/A
Scalloped hammerhead shark	Eastern Atlantic; Central and SW Atlantic	Threatened	2014	Not designated	N/A
Shortnose sturgeon	N/A	Endangered	1967	Not designated	N/A
Smalltooth sawfish	U.S.	Endangered	2003	Designated	No
Corals					
Boulder star coral	N/A	Threatened	2014	Proposed	N/A
Elkhorn coral	N/A	Threatened	2006	Designated	Yes
Lobed star coral	N/A	Threatened	2014	Proposed	N/A
Mountainous star coral	N/A	Threatened	2014	Proposed	N/A
Pillar coral	N/A	Threatened	2014	Proposed	N/A
Rough cactus coral	N/A	Threatened	2014	Proposed	N/A
Staghorn coral	N/A	Threatened	2006	Designated	Yes

N/A = not applicable indicates no distinct population segment or critical habitat has been designated

4.9.1 Species Considered but Discounted from Further Analysis

Potential interactions with the Atlantic salmon, giant manta ray, gulf sturgeon, hawksbill sea turtle, humpback whale, Nassau grouper, oceanic whitetip shark, scalloped hammerhead shark, Rice's whale, and smalltooth sawfish are not expected in the Project area, but these species may be affected by transits from distant port locations during construction and installation of the proposed Project. In other cases, the occurrence of the species in the Action Area, such as shortnose sturgeon, is so unlikely or rare that the potential for adverse effects is discountable.

4.9.1.1 Atlantic Salmon

The endangered Gulf of Maine DPS of Atlantic salmon (*Salmo salar*) has not been found to occur in the Project area (BOEM 2018a). Gulf of Maine Atlantic salmon are not expected to occur south of central New England, and the population forages primarily between West Greenland and the Labrador Sea. Significant spawning rivers for this species are the Penobscot River, Kennebec River, and Sheepscot River in Maine (Rikardsen 2021; USASAC 2020). Smolts migrate from their natal river to foraging grounds in the Western North Atlantic, and after one or more winters at sea, adults return to their natal river to spawn (Fay et al. 2006). The Proposed Action vessel transit routes from Canada would not overlap the critical habitat of Atlantic salmon (Figure 3.1-2), which includes perennial rivers, streams, estuaries, and lakes connected to the marine environment in coastal Maine. It is noted that even if Atlantic salmon presence overlapped with vessel transit routes, vessel strikes are not an identified threat to the species (74 FR 29344) or their recovery (NMFS and USFWS 2019). Therefore, effects to Atlantic salmon are not expected as a result of the Proposed Action and the species is discounted from further analysis in this BA.

4.9.1.2 Giant Manta Ray

The giant manta ray (*Mobula birostris*) is listed as threatened throughout its range (NMFS 2018a). This highly migratory species is found in temperate, subtropical, and tropical oceans worldwide. Sightings of giant manta rays in New England are rare, although individuals have been documented as far north as New Jersey and Block Island (BOEM 2021 citing Gudger 1922; BOEM 2021 citing Miller and Klimovich 2017). In sightings compiled from 1925 to 2020 by Farmer et al. (2021) all sightings of giant manta rays, north of New Jersey, occurred along the boundary of the Atlantic OCS. The presence of giant manta rays may overlap areas traversed by vessels coming north along the coast, as well as in the portions of the Action Area where vessels would transit to and from the Gulf of Mexico. However, the encounter rate between this species and Project vessels is expected to be low. Additionally, the barge vessels associated with the Project that would be transiting the Gulf of Mexico are expected to be moving at maximum speeds of 6 knots in the Gulf of Mexico and 6.5 knots north of Miami, which is slow enough for the vessel to alter course to mitigate vessel strikes. The mitigation measures proposed for all Project vessels to steer course away from giant manta rays and follow vessel strike avoidance measures would further reduce the chance of any adverse effects to this species from the Proposed Action (BA-7, Table 3.3-2).

Given the limited number of vessel transits through the portion of the Action Area where this species is most likely to occur (i.e., the portion associated with vessel transits to ports south of New Jersey including the Gulf of Mexico), which would amount to 87 trips during the entire construction period originating in Sparrows Point Port, Maryland; Port of Charleston, South Carolina; Port of Corpus Christi, Texas; or the Port of Altamira, Tamaulipas, Mexico (Table 3.1-14). During the O&M phase four trips are expected, two from Maryland and two from South Carolina, and during decommissioning nine trips are expected from Texas (Table 3.1-14). Further, all ports south of New England have a low likelihood of being used, and if used, would be used minimally. The dispersed distribution of giant manta rays in the open ocean habitat where Project vessel transits would occur, the slow speeds of vessel transit in the southern portions of the Action Area, the limited number of trips and the mitigation measures to avoid vessel strikes, effects to giant manta ray are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.3 Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is listed as threatened throughout its range (USFWS and NOAA 1991). Gulf sturgeon is found from Lake Pontchartrain in Louisiana to the Suwannee River in Florida (NMFS 2023m). This anadromous species spawns in freshwater in the spring and fall, over summering in freshwater habitats between those seasons. After the fall spawning period, Gulf sturgeon move into estuarine waters to feed. Younger age classes remain in freshwater or estuarine environments year-round. Once Gulf sturgeon reach two to three years of age, they move into marine waters of the Gulf of Mexico during the winter before returning to freshwater in the spring (NMFS 2023m). Gulf sturgeon are generally found in coastal waters from October or November to February or March (Ross et al. 2009). In the marine environment, this species occupies shallow waters (i.e., 32.8 feet [10 meters] or less) (Edwards et al. 2003, 2007; Fox et al. 2002; Ross et al. 2009; Ross et al. 2009 citing Sulak and Clugston 1999). Given this species' distribution, it would not occur in the Project area, or the portion of the Action Area associated with vessel transits to local regional ports.

Gulf sturgeon have the potential to occur in the portion of the Action Area associated with vessel transits to and from the Gulf of Mexico. However, vessels transiting to and from Corpus Christi, Texas and the Port of Altamira, Mexico, are expected to follow general traffic patterns through the Straits of Florida and across the Gulf of Mexico, far offshore of the shallow nearshore waters occupied by Gulf sturgeon during its overwintering period. Additionally, the barge vessels associated with the Project that would be transiting the Gulf of Mexico are expected to be moving at maximum speeds of 6 knots in the Gulf of Mexico. Further, the ports in the Gulf of Mexico have a low likelihood of use and if they are used would be used minimally; 71 trips over the entire construction period are expected between either Corpus Christi, Texas or Port of Altamira, Tamaulipas, Mexico, no trips are expected during the O&M phase, and nine trips are expected from the Port of Corpus Christi, Texas during decommissioning (Table 3.1-14). Given the habitat preference and seasonality of Gulf sturgeon in the marine environment, and the slow speeds at which vessels may be traveling through the Gulf of Mexico, Project vessels are not expected to encounter or injure Gulf sturgeon. Therefore, effects to Gulf sturgeon are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.4 Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricata*) is listed as endangered throughout its wide spatial range (USFWS 1970). Though hawksbill sea turtles have been documented in OCS waters of the northwest Atlantic Ocean, they are very rarely seen in Massachusetts and Rhode Island waters, and observations are typically the result of cold-stun strandings (Lutz and Musick 1997; NMFS and USFWS 1993). Therefore, this species is considered unlikely to occur in the Project area.

Hawksbill sea turtles occur regularly in the Gulf of Mexico and could therefore occur in the portion of the Action Area associated with vessel transits to and from this region and from international transit routes through the Panama Canal. A limited number of vessel transits are expected through the Gulf of Mexico or regions south of New England waters. A total of 87 trips, during the entire construction period, are expected to originate in Sparrows Point Port, Maryland; Port of Charleston, South Carolina; Port of Corpus Christi, Texas; or the Port of Altamira, Tamaulipas, Mexico. (Table 3.1-14). During the O&M phase four trips are expected, two from Maryland and two from South Carolina, and during decommissioning nine trips are expected from Texas (Table 3.1-14). Hawksbill sea turtles generally inhabit nearshore foraging grounds and are often associated with coral reefs (NMFS 2023). Therefore, as the vessel will be transiting through the Straits of Florida and across the Gulf of Mexico in offshore waters, hawksbill sea turtle densities along vessel transit routes are expected to be low. If a Project vessel were to encounter a hawksbill sea turtle in the Action Area, any potential impacts would be minimized by the implementation of mitigation measures to avoid vessel strikes. At-sea vessels transiting from non-local ports traveling greater than 10 knots will utilize dedicated, trained lookouts or Protected Species

Observers (PSO), or NMFS-approved visual detecting devices. Project vessels will maintain a separation distance of 164 feet (50 meters) or greater from any sighted sea turtles and adhere to vessel strike avoidance measures as outlined in Table 3.3-1. Additionally, the barge vessels associated with the Project that would be transiting the Gulf of Mexico are expected to be moving at maximum speeds of 6 knots in the Gulf of Mexico.

Given the low density of hawksbill sea turtles, the low expected use of non-local ports, and the slow speeds at which vessels will be traveling across the Gulf of Mexico, the likelihood of an encounter resulting in a ship strike is very low. In addition, the mitigation measures to avoid vessel strikes would reduce the chance of any adverse effects to this species if an encounter did occur. Therefore, effects to hawksbill sea turtles are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.5 Humpback Whale

The humpback whale (*Megaptera novaeangliae*) can be found worldwide in all major oceans from the equator to sub-polar latitudes. In the summer, humpbacks are found in high-latitude feeding grounds while during the winter months, individuals migrate to tropical or subtropical breeding grounds to mate and give birth (Hayes et al. 2020). North Atlantic humpback whales feed during the summer in various locations in cooler, temperate regions, including the Gulf of Maine, Newfoundland/Labrador, the Gulf of St. Lawrence, Greenland, Iceland, and Norway, including Svalbard (Wenzel et al. 2020). Available photo-identification and genotyping data indicate humpbacks from all these feeding grounds migrate to the primary winter breeding ground in the Dominican Republic (Wenzel et al. 2020). However, smaller numbers have been observed wintering around the Cape Verde Islands (Wenzel et al. 2020; Cooke 2018a). The designation of the Cape Verde/Northwest Africa distinct population segment (DPS) was based on genetic evidence indicating a second breeding ground occupied by humpback whales feeding primarily off Norway and Iceland (Bettridge et al. 2015; Wenzel et al. 2020). Surveys conducted between 2010 and 2018 estimated 272 non-calf whales in the Cape Verde/Northwest Africa DPS using photo-identification survey methods (Wenzel et al. 2020). Although the population abundance for this DPS remains unknown, resighting rates suggest a small population size (Wenzel et al. 2020). Humpback whales were subject to significant removals by pre-modern whalers especially in their wintering grounds in the West Indies and Cape Verde Islands (Smith and Reeves 2003). Whaling in the Cape Verde Islands occurred primarily during 1850 to 1912 with a total estimated kill of about 3,000 animals (Reeves et al. 2002). Humpback whales from the Cape Verde/Northwest Africa DPS potentially occurring in the Action Area would be limited to those individuals located within or around the summer feeding grounds off Norway and Iceland where they may encounter Project vessels originating from ports in Europe. However, given this DPS is primarily present in European waters in the summer, interactions with Project vessels in Europe would be uncommon and limited to the whales migration to and from feeding/breeding grounds. Given the small size of this DPS and their limited presence in European waters, effects to this humpback whale DPS are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.6 Nassau Grouper

The Nassau grouper (*Epinephelus striatus*) is listed as threatened throughout its range (NMFS 2016c). This species is found in tropical and subtropical waters of the Caribbean Sea and the western North Atlantic Ocean. In U.S. waters, this species is found in southern Florida, Puerto Rico, and the U.S. Virgin Islands (NMFS 2023n). There has been one confirmed sighting of Nassau grouper in the Gulf of Mexico at Flower Gardens Bank. This species prefers shallow benthic reef habitats but may be found to depths of 426 feet (130 meters) (NMFS 2023n). Juveniles are observed in nearshore macroalgal and seagrass beds, and adults spend most of their time within caves and relief features of reefs. Given its distribution, Nassau grouper would not occur in the Project area or the portion of the Action Area associated with vessel transits to local regional ports.

Nassau grouper have the potential to occur in the portion of the Action Area associated with vessel transits to and from the Gulf of Mexico and routes associated with the Panama Canal. However, given its rarity in the Gulf of Mexico, the limited number of trips and low likelihood of use of Gulf of Mexico ports or the Panama Canal route, its lack of time spent near the surface and preference for shallow benthic reef habitats, and the slow speeds at which vessels may be traveling through the southern portions of the Action Area, Project vessels are not expected to encounter or injure Nassau grouper. Therefore, effects to Nassau grouper are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.7 Oceanic Whitetip Shark

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as threatened throughout its range (NMFS 2018b). This species is generally found in tropical and subtropical oceans worldwide, inhabiting deep, offshore waters generally deeper than 604 feet (184 meters) (NMFS 2018b). The species has a clear preference for open ocean waters between latitudes of 10°N and 10°S but can be found in decreasing numbers out to 30°N and 35°S, with abundance decreasing with greater proximity to continental shelves (Young et al. 2017). In the western Atlantic Ocean, oceanic whitetip sharks occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. In the central and eastern Atlantic Ocean, the species occurs from Madeira, Portugal, south to the Gulf of Guinea, and possibly in the Mediterranean Sea (NMFS 2016b).

Given the species' preference for deep, offshore waters, it is possible but unlikely that they will transit through the Project area. There is a small chance that vessel transits and transport of Project components from the Gulf of Mexico or international ports would interact with oceanic whitetip sharks in the vessel traffic component of the Action Area. Vessels at sea would not be expected to travel at reduced speeds. However, given the low density of oceanic whitetip sharks and the low number of vessel transits from non-local ports, the likelihood of an encounter resulting in a ship strike is very low. Further, vessel strikes have not been identified as a threat to the species (NMFS 2018b), and there is no information to indicate that vessels would have adverse effects on this species (BOEM 2021). Given that project vessels are not expected to encounter oceanic whitetip shark, effects to this species are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.8 Scalloped Hammerhead Shark

The scalloped hammerhead shark (*Sphyrna lewini*), listed as threatened, is a moderately large shark with a global distribution. Animals from two DPSs may occur in the Action Area but are not expected in the Project area. These include animals in: (1) the Eastern Atlantic DPS, which occur in the Eastern Atlantic and Mediterranean Sea (79 FR 38214) and (2) the Central and Southwest Atlantic DPS, which include all waters of the Caribbean Sea and range as far north as central Florida. The primary factors responsible for the decline of the listed scalloped hammerhead shark DPSs are overutilization, due to both catch and bycatch of these sharks in fisheries, and inadequate regulatory mechanisms for protecting these sharks, with illegal fishing identified as a significant problem (79 FR 38213). ESA-listed scalloped hammerhead sharks in the Action Area would only be encountered by Project vessels transiting from ports in Europe, the Gulf of Mexico, or transit routes through the Panama Canal. Because only a limited number of Project vessels would transit from these locations to the wind farm area and reported vessel strikes for this species are low, the potential for vessel strikes occurring that result in serious injury or mortality is low, effects to this species are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.9 Rice's Whale

Rice's whale (*Balaenoptera ricei*) is listed as endangered throughout its range (NMFS 2019b). This species was originally classified as the Gulf of Mexico subspecies of Bryde's whale (*Balaenoptera edeni*) at the time of listing but was reclassified as a distinct species in 2021 (Rosel et al. 2021). This species is not found within the Project area or within the portion of the Action Area where vessels transit to and from local regional ports. Rice's whale only occurs in the Gulf of Mexico and has been consistently sighted in the northeastern Gulf of Mexico. They are generally distributed along the continental shelf break between 328 and 1,312 feet (100 and 400 meters) depth (NMFS 2023k), and critical habitat was proposed but not yet designated for them in July 2023 in the U.S. waters of the Gulf of Mexico between those depth contours (88 FR 47453). The occurrence of this species would be limited to the portion of the Action Area where vessel transits to and from ports on the western coast of the Gulf of Mexico.

Given the rarity of this species (estimated abundance of 51 individuals; Hayes et al. 2021), the limited Project vessel traffic to ports in the Gulf of Mexico, the species preference for habitats in the northeastern Gulf of Mexico that would not be likely to overlap vessel transit routes to ports on the west coast of the Gulf of Mexico, and the slow speeds (6 knots or lower) at which barges associated with the Project may be traveling through the Gulf of Mexico, it is extremely unlikely that a Project vessel would encounter or injure Rice's whales. If a Project vessel were to co-occur with a Rice's whale in the Action Area, any effects are extremely unlikely due to the implementation of vessel strike avoidance measures (Table 3.3-1). All Project vessels will utilize dedicated, trained lookouts to reduce the risk of vessel collision, will maintain 328-foot (100-meter) separation distances from large whales, and adhere to vessel strike avoidance measures as advised by NMFS. Based on the unexpected co-occurrence of Rice's whales and Project vessels in the Action Area and the mitigation measures already in place to avoid vessel strikes with whales, effects to Rice's whale are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.10 Shortnose Sturgeon

The shortnose sturgeon (*Acipenser brevirostrum*) is listed as endangered throughout its range (USFWS 1967). It is an anadromous finfish species found mainly in large freshwater rivers and coastal estuaries located along the east coast of North America, from New Brunswick to Florida. Based on its habitat preferences, shortnose sturgeon may occur in nearshore waters and rivers (Bemis and Kynard 1997; Zydlewski et al. 2011) though movement of shortnose sturgeon between rivers is rare, and their presence in the marine environment is uncommon (Kynard 1997, Bain et al. 2007). Shortnose sturgeon are grouped into three metapopulations (northern, mid-Atlantic, southern) and can be found in 41 rivers and bays along the East Coast of North America (BOEM 2018a). Shortnose sturgeon exhibit variable site fidelity. For example, the Hudson River population is almost exclusively confined to the river (Kynard et al. 2016; Pendleton et al. 2019), differing from other populations that may use coastal waters to move into smaller coastal rivers nearby.

There is a dearth of recent shortnose sturgeon distribution and density data for areas where shortnose sturgeon could occur in the Project area. Little is known about shortnose sturgeon density in Mount Hope Bay and the rivers that drain into it, such as the Lee River (near Brayton Point landfall location) and the Taunton River. A survey conducted by Buerkett and Kynard (1993) caught no shortnose sturgeon in Mount Hope Bay and the Taunton River, and ultimately concluded shortnose sturgeon are not present in the river. Shortnose sturgeon in the Chesapeake Bay primarily inhabit the Potomac River and Susquehanna River (NOAA Fisheries 2023). The mouth of the Potomac River is downriver of the Sparrows Point Port in Maryland, and the mouth of the Susquehanna River is upriver of the Sparrows Point Port in Maryland. Currently only eight trips are planned from the Sparrows Point Port for the entire construction phase and only two trips planned for the entirety of the O&M phase, further this port has a low likelihood of being used (Table 3.1-14). Based on current known distributions, this species is unlikely to occur in the Project area or in the Action Area. Therefore, given the low likelihood of occurrence, effects to shortnose sturgeon are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.11 Smalltooth Sawfish

The U.S. DPS of smalltooth sawfish (*Pristis pectinata*) is listed as endangered (NMFS 2003). This species lives in tropical seas and estuaries of the Atlantic Ocean (NMFS 2023o). In the U.S., smalltooth sawfish are generally demersal and found in shallow, coastal waters and lower river reaches along the southwest coast of Florida from Charlotte Harbor through the Everglades and Florida Keys. Given its distribution, this species would not occur in either the Project area or the portion of the Action Area associated with vessel transits to local regional ports.

Smalltooth sawfish have the potential to occur in the portion of the Action Area associated with vessel transits to and from ports in the Gulf of Mexico. However, vessels transiting to and from Corpus Christi, Texas or the Port of Altamira, Mexico are expected to follow general traffic patterns through the Straits of Florida and across the middle of the Gulf of Mexico, which is offshore of the shallow coastal waters occupied by smalltooth sawfish on the west coast of Florida. Further a limited number of trips and low likelihood of use of Gulf of Mexico ports is expected (Table 3.1-14). Given that its preferred habitat does not overlap with vessel transit routes, and the slow speeds at which vessels may be traveling through the Gulf of Mexico (6 knots or lower), Project vessels are not expected to encounter or injure smalltooth sawfish. Therefore, effects to this species are not expected as a result of the Proposed Action and discounted from further analysis in this BA.

4.9.1.12 ESA-Listed Corals

There are seven species of coral found in the waters of Florida and the Gulf of Mexico that are listed as threatened throughout their range: elkhorn coral (NMFS 2006), staghorn coral (NMFS 2006), boulder star coral (*Orbicella franksi*) (NMFS 2014b), lobed star coral (*O. annularis*) (NMFS 2014b), mountainous star coral (*O. faveolata*) (NMFS 2014b), pillar coral *(Dendrogyra cylindrus*) (NMFS 2014b), and rough cactus coral (*Mycetophyllia ferox*) (NMFS 2014b).

These corals would not occur in the Project area, or the portion of the Action Area associated with vessel transits to regional ports but may occur in the portion of the Action Area associated with vessel transits to and from the Gulf of Mexico that are limited to smaller support vessels and with minimal number of transits expected to occur throughout the life of the Project (Section 3.1.2.6). As corals are benthic species, they would not be vulnerable to vessel strike by Project vessels. Therefore, the Proposed Action is expected to have **no effect** on ESA-listed corals.

4.9.2 Species Considered for Further Analysis

Ten ESA-listed species under NMFS jurisdiction are likely to occur in the Project area, the ensonified area, and/or along vessel transit routes to regional ports within the action area and are therefore considered for further analysis: five large whale species (blue whale, fin whale, NARW, sei whale, and sperm whale), four sea turtle species (green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle), and one fish species (Atlantic sturgeon). General information about these species, status, threats, and additional information about habitat use that is pertinent to this consultation are described in the succeeding sections.

4.9.2.1 Marine Mammals

There are five marine mammal species under the ESA that are likely to occur in the Action Area and that have not been discounted from further analysis. The species carried forward in this BA are large whales:

fin whale (*Balaenoptera physalus*), NARW (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), and blue whale (*Balaenoptera musculus*). Blue whales, while considered rare migrants in the U.S. Atlantic (Hayes et al. 2020), have been sighted in the Project area (Stone et al. 2017; Kraus et al. 2016). As noted in Section 4.8, there is designated critical habitat for NARW within the Action Area, although no other critical habitats have been designated for other ESA-listed marine mammals.

Mean monthly marine mammal density estimates (animals/100 square kilometers) for all species were obtained using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022) and include recently updated model results for NARW. The updated model includes new estimates for NARW abundance in Cape Cod Bay in December. Additionally, model predictions are summarized over three eras, 2003–2019, 2003–2009, and 2010–2019, to reflect the apparent shift in NARW distribution around 2010. The modeling uses survey data from 2010-2019 for density predictions as recommended by Roberts et al. 2022. Mean monthly whale density estimates in the Lease Area are shown in Table 4.9-2.

Table 4.9-2. Mean monthly marine mammal density estimates for ESA-listed species within 5 km of the SouthCoast Wind Lease Area

Month	Blue Whale Density (number / 100 km2)	Fin Whale Density (number / 100 km2)	NARW Density (number / 100 km2)	Sei Whale Density (number / 100 km2)	Sperm Whale Density (number / 100 km2)
January	–	0.218	0.422	0.038	0.045
February	–	0.175	0.478	0.025	0.016
March	–	0.144	0.430	0.050	0.016
April	–	0.149	0.424	0.119	0.004
May	–	0.302	0.323	0.193	0.017
June	–	0.292	0.059	0.064	0.031
July	–	0.474	0.032	0.016	0.056
August	–	0.360	0.020	0.012	0.170
September	–	0.269	0.031	0.019	0.100
October	–	0.081	0.050	0.040	0.072
November	–	0.052	0.081	0.089	0.043
December	–	0.142	0.246	0.067	0.029
Annual Mean	0.001	0.222	0.216	0.061	0.050
May to December Mean	–	0.247	0.105	0.063	0.065

km = kilometer; km^2 = square kilometer; NARW = North Atlantic right whale
dash (—) indicates that (Blue Whale) density is predicted annually (Roberts et al. 2016)
Source: Density estimates are from habitat-based density modeling of the entire Atlantic Exclusive Economic Zone (EEZ) from Roberts et al. (2016, 2022a-e).

Species descriptions, status, likelihood, and timing of occurrence in the Action Area, information about feeding habits, and hearing ability of the five ESA-listed marine mammals are discussed in the sections that follow.

4.9.2.1.1 Blue Whale

Description and Life History

In the North Atlantic Ocean, the range of blue whales (*Balaenoptera musculus*) extends from the subtropics to the Greenland Sea. As described in the most recent stock assessment report, blue whales have been detected and tracked acoustically in much of the North Atlantic, with most of the acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles (Hayes et al. 2020). Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence River, Newfoundland; Nova Scotia; New England; and Greenland all belong to the same stock, whereas blue whales photographed off Iceland and the Azores appear to be part of a separate population (CETAP 1981; Sears and Calambokidis 2002; Sears and Larsen 2002; Wenzel et al. 1988). The largest concentrations of blue whales are found in the lower St. Lawrence Estuary (Comtois et al. 2010; Lesage et al. 2007), which is outside of the Action Area (most northern port is located in Sheet Harbor, Nova Scotia). Blue whales do not regularly occur within the U.S. Exclusive Economic Zone (EEZ) and typically occur farther offshore in areas with depths of 328 feet (100 meters) or more (Waring et al. 2011).

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 and 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 and 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). This hearing group has a generalized hearing range of 7 hertz (Hz) to 35 kilohertz (kHz).

Status and Population Trend

Blue whales have been listed as endangered under the ESA Endangered Species Conservation Act of 1969, with a recovery plan published under 63 FR 56911 (*Federal Register* 2018). No critical habitat has been designated for the blue whale. Blue whales are separated into two major populations (the north Pacific and north Atlantic population) and further subdivided in stocks. The North Atlantic Stock includes mid-latitude (North Carolina coastal and open ocean) to Arctic (Newfoundland and Labrador) waters. However, historical observations indicate that the blue whale has a wide range of distribution from warm temperate latitudes typically in the winter months and northerly distribution in the summer months. Blue whales are known to be an occasional visitor to U.S. Atlantic EEZ waters, with limited sightings. Population size of blue whales off the eastern coast of the U.S. is not known; however, a catalogue count of 402 individuals from the Gulf of St. Lawrence is the minimum population estimate (NOAA Fisheries 2020).

Distribution and Habitat Use

Blue whales were detected acoustically during the Northeast Large Pelagic Survey (NLPS) but were not visually observed in the Massachusetts and Rhode Island WEA between 2011 and 2015 (Kraus et al. 2016). Three blue whale observations were recorded in the northeast U.S. Atlantic during the 2010–2013 AMAPPS summer/fall shipboard surveys, all of which occurred during the summer months (Palka et al. 2017). No blue whale observations were recorded during visual or acoustic surveys conducted in the Project area (AIS Inc. 2020; Mayflower-APEM 2020a–2020m). This species is expected to occur in deeper waters (at least 328 feet [100 meters]) than those found in the Lease Area (BOEM 2021 citing Waring et al. 2010).

Blue whales have been acoustically detected throughout much of the North Atlantic. Most of these detections occurred around the Grand Banks off Newfoundland and west of the British Isles. This species is considered an occasional visitor in U.S. Atlantic waters (Hayes et al. 2020).

The mean abundance of blue whales in the Project area from 1998 to 2020 is estimated at less than one individual (0.000–0.016 / 29.15 square nautical miles [100 square kilometers]) (Roberts et al. 2022a).

4.9.2.1.2 Fin Whale

Description and Life History

The fin whale (*Balaenoptera physalus*) is the second-largest species of whale, reaching a maximum weight of 40 to 80 tons (36 to 73 metric tons) and a maximum length of 75 to 85 feet (23 to 26 meters) (NMFS 2023). This species reaches physical maturity at 25 years of age. Age of sexual maturity varies between sexes; males reach sexual maturity at 6 to 10 years of age, and females mature between the age of 7 and 12 years. The gestation period for fin whales is 11 to 12 months, and females give birth in tropical and subtropical areas in midwinter (NMFS 2023).

Fin whales are mysticetes (i.e., baleen whales) and forage using lunge or skim feeding. This species feeds during summer and fasts during the winter migration (NMFS 2023). Primary prey species include krill, squid, herring, sand lance, and copepods (Kenney and Vigness-Raposa 2010).

For the purposes of evaluating underwater noise impacts, marine mammals have been organized into groups based on their hearing physiology and sensitivity (NMFS 2018). All mysticetes, including fin whales, are classified as low-frequency cetaceans. This hearing group has a generalized hearing range of 7 hertz to 35 kilohertz.

Status and Population Trend

The fin whale was listed as endangered in 1970, as part of a pre-cursor to the ESA (USFWS 1970). The status of this species was most recently reviewed as part of its 5-year status review in 2019, and NMFS (2019) determined that the species should be down listed from endangered to threatened. However, no rulemaking has been proposed to reclassify the species under the ESA. Fin whales found in the Action Area belong to the Western North Atlantic stock. The best abundance estimate for the Western North Atlantic stock is 6,802 individuals (Hayes et al. 2022). There are currently insufficient data to determine a population trend for this species.

Threats to fin whales include vessel strikes, entanglement, anthropogenic noise, and climate change. This species is likely the second most vulnerable species to vessel strikes following NARW (NMFS 2023). In a study evaluating historic and recent vessel strike reports, fin whales were involved in collisions the most frequently of the 11 large species evaluated (Laist et al. 2001). Though entanglement can result in injury or mortality in this species, fin whales may be less susceptible to entanglement than other large whale species (Glass et al. 2010; Nelson et al. 2007).

Distribution and Habitat Use

Fin whales inhabit deep, offshore waters of every major ocean and are most common in temperate to polar latitudes (NMFS 2023). In the U.S. Atlantic, fin whales are common in shelf waters north of Cape Hatteras, North Carolina, and are found in this region year-round (Edwards et al. 2015; Hayes et al. 2020). This species most commonly occupies waters along the 328-foot (100-meter) isobath but may be found in both shallower and deeper waters (Kenney and Winn 1986). Fin whale migratory patterns are complex. Most individuals in the North Atlantic migrate between summer feeding grounds in the Arctic in the Labrador/Newfoundland region and winter breeding and calving areas in the tropics around the West Indies (NMFS 2023).

Fin whales may occur in the Action Area year-round. Recordings during the NLPS (i.e., detected visually or acoustically) in the Massachusetts and Rhode Island lease areas and the Project area reported peak occurrences during the late spring and summer (Kraus et al. 2016) and were observed during both the 2010–2013 AMAPPS I summer/fall shipboard and aerial surveys and the AMAPPS II 2015-2019 surveys (Palka et al. 2017, 2021). The Marine-life Data and Analysis Team (MDAT) models estimated a monthly average of 0.1 to 0.5 fin whales occurring per 24,710 acres (10,000 hectares) in the Lease Area (Roberts et al. 2018).

Modeled fin whale abundance from 1998 to 2020 shows peak abundances in the Project area occurring from April to August, at approximately 0.40-0.63 fin whales/29.15 square nautical miles (100 square kilometers) (Roberts et al. 2022b). Fin whales also use the nearby Nantucket Shoals, with modeled density peaks in June and July at approximately 1 to 1.6 fin whales/29.15 square nautical miles (100 square kilometers) (Roberts et al. 2022b).

4.9.2.1.3 North Atlantic Right Whale

Description and Life History

The NARW (*Eubalaena glacialis*) is a large mysticete that can reach lengths up to 52 feet (16 meters) and weighs up to 70 tons (64 metric tons) at maturity, with females being larger than males (NMFS 2023a). This species may live to 70 years of age or more. The NARW is recognized to be a separate species from the Southern right whale (*Eubalaena australis*), separated into distinct populations in the northern Atlantic and Pacific Oceans. The Western Atlantic population, what is known as the NARW, ranges from calving grounds in coastal waters of the southeastern U.S. to primary feeding grounds off New England, the Canadian Bay of Fundy, the Scotian Shelf, and the Gulf of St. Lawrence. During spring and summer months, NARW migrate north to the productive waters of the northeast region to feed and nurse their young. Female NARWs reach sexual maturity at approximately age 10 and have a calf every 3 to 4 years, although in recent years the time span between calvings has increased approximately to 6 to 10 years (NMFS 2023a). The gestation period is approximately 1 year, and calves are born primarily in the coastal waters of South Carolina, Georgia, and Florida.

The NARW is primarily planktivorous, preferentially targeting certain calanoid copepod species (*Pseudocalanus* and *Centropages* spp.), and primarily the late juvenile developmental stage of *Calanus finmarchicus* (McKinstry et al. 2013; Hudak et al. 2023). NARW feeding behavior varies by region in response to different seasonal and prey availability conditions. For example, NARWs may rely more frequently on skim-feeding when in transit between core habitats, or when dense concentrations of prey are less available (Whitt et al. 2013). Baumgartner et al. (2017) investigated NARW foraging ecology in the Gulf of Maine and southwestern Scotian Shelf using archival tags. The study reported that NARW diving behavior was variable but followed distinct patterns correlated with the vertical distribution of forage species in the water column, and notably 72 percent of their time were spent within 33 feet (10 meters) of the surface. Although NARWs are always at risk of ship strike when breathing, the risk increases substantially due to their black coloration, the absence of a dorsal fin, and the tendency to forage near but below the surface, making them hard to detect (Baumgartner et al. 2017).

Marine mammals are organized into groups based on their hearing physiology and sensitivity (NMFS 2018). All mysticetes, including NARWs, are classified as low-frequency cetaceans. This hearing group has a generalized hearing range of 7 hertz to 35 kilohertz. A study of the inner ear anatomy of NARWs estimated a hearing range of 10 hertz to 22 kilohertz (Parks et al. 2007).

Status and Population Trend

The NARW was listed as endangered in 1970 as part of a precursor to the ESA (USFWS 1970). The status of this species was most recently reviewed in 2022 as part of the species' 5-year status review, and its endangered status remains unchanged (NMFS 2022a). NARWs found in the Project area belong to the Western North Atlantic stock. Using data as of September 7, 2021, the latest Pace model (Pace et al. 2017) estimate for the size of the remaining NARW population in 2020 is 368 individuals (95% confidence range +/-14) (NMFS 2023a, Pettis et al. 2022). However, the most recent 2022 NMFS stock assessment report gives a population estimate of 338 NARWs (Hayes et al. 2023). In 2017, an Unusual Mortality Event (UME) began for NARW, totaling 34 dead stranded whales: 21 in Canada and 13 in the U.S. (NMFS 2023g). Entanglement in fishing gear and ship strikes were the causes of mortality during the UME. In addition, 16 live free-swimming non-stranded whales have been documented with serious injuries from entanglements or vessel strikes from 2017 to 2021, bringing the preliminary cumulative total number of animals in the NARW UME up to 50 individuals. Given that there are 338 NARWs remaining, these 50 individuals in the UME represent a substantial loss of a critically endangered species (Pettis et al. 2022).

Threats to NARW include vessel strikes, entanglement, anthropogenic noise, and climate change. Vessel strike and entanglement are the leading causes of death in this species (Kite-Powell et al. 2007; Knowlton et al. 2012, Pettis et al. 2022). From 2002 to 2006, NARW was subject to the highest proportion of vessel strikes and entanglements of any species evaluated (Glass et al. 2010). As this species spends a relatively high proportion of time at the surface and is a slow swimmer, NARW are particularly vulnerable to vessel strike, and most strikes are fatal (Jensen and Silber 2004). A total of 86 percent of NARWs show evidence of past entanglements, and entanglement may also be limiting population recovery (Pettis et al. 2022).

Distribution and Habitat Use

NARW is found primarily in coastal waters, though the species also occurs in deep, offshore waters (NMFS 2023a). In the U.S. Atlantic, NARW range extends from Florida to Maine. This species exhibits strong migratory patterns between high-latitude summer feeding grounds in New England and Canada and low-latitude winter calving and breeding grounds in the shallow, coastal waters off South Carolina, Georgia, and northern Florida.

NARWs are considered common visitors to the Project area with hotspots consistently observed along the northeastern boundary of the Lease Area, adjacent to the Nantucket Shoals, during surveys in spring 2011–2015, spring 2017–2019, and winter 2017–2019 (Quintana-Rizzo et al. 2021). From 2015 to 2019, Palka et al. (2021) reported acoustic detections of NARWs in all seasons in the northeastern portion of the Lease Area, with the highest number of days of acoustic detections in the winter and spring; with 22 to 67 days of acoustic detections from November to February and again from March to April. Generally, the highest densities of whales occur east of the Lease Area over Nantucket Shoals and may occur in any season in the Project area. There is also the potential for NARW year-round occurrence in the proposed ECCs, specifically near Brayton Point ECC, with a greater likelihood of occurrence during spring and winter months.

During 2018–2021 New England Aquarium (NEAq) aerial survey activities (Campaign 5 and Campaign 6b), NARWs were the third most observed whale species (O'Brien et al. 2022). In total, 175 sightings of 321 NARWs were recorded during Campaign 5. During Campaign 5, the majority of sightings occurred in the Nantucket Shoals, within 20 nautical miles (37 kilometers) of offshore wind lease areas, with one NARW sighted on the boundary of the SouthCoast Wind and Beacon Wind Lease Areas (O'Brien et al. 2021). During Campaign 6B, 90 sightings of 169 NARWs were recorded with all sightings outside of the Lease Area, but within 15 nautical miles (28 kilometers) of the Massachusetts lease areas (O'Brien et al.

2022). In 2021, two to five NARW were observed in the northeastern portion of the Lease Area during the Winter, while in the Spring, two to five NARW were observed in the southwest portion of the Lease Area (O'Brien et al. 2021, 2022). Modeled density of NARW from 2011 to 2020 peaked in the winter and spring months. During these months (November to May), abundance ranged from 0.16 to 1 NARW/29.15 square nautical miles (100 square kilometers) (Roberts et al. 2022e).

While the Project area does not occur in any designated critical habitat areas for NARWs, the Lease Area is adjacent to Nantucket Shoals, which is a recently identified foraging area for NARWs. The physical oceanographic and bathymetric features provide for year-round high phytoplankton biomass, likely contributing to increased availability of zooplankton prey for NARWs (Quintana-Rizzo et al. 2021). Waters from the Gulf of Maine, the Great South Channel, and Nantucket Sound mix in the shallow dune-like Nantucket Shoals. The convergence of these waters creates a well-mixed water column throughout the year (Limeburner and Beardsley 1982), making the Nantucket Shoals the only known winter foraging ground for NARWs (Quintana-Rizzo et al. 2021).

Observations of NARW in Nantucket Shoals have occurred year-round, primarily during winter and spring (Quintana-Rizzo et al. 2021, O'Brien et al. 2022). Similarly, modeled NARW abundance in the Nantucket Shoals from 2011 to 2020 also reports peak abundances in the winter and early spring months, with densities from January to May peaking at 4 to 6.3 NARW/29.15 square nautical miles (100 square kilometers) and again in November and December (Roberts et al. 2022e). Recently, the presence of NARWs has also increased in the summer and fall, which overlaps with the current schedule for pile-driving for projects in the Rhode Island and Massachusetts WEAs (Quintana-Rizzo et al. 2021). In earlier years (2012–2015), NARW sighting rates were zero from May through November, but in later years (2017–2019) NARW were cited in all months except October (Quintana-Rizzo et al. 2021). As can be noted in the reports presented above, NARWs have become more common in southern New England waters and are staying in these waters for longer periods. This is likely due to prey items shifting northward and finding favorable conditions in Nantucket Shoals as NARW feeding has been observed in all seasons in the area. This increasing occurrence trend could mean an extension of critical habitat into southern New England waters (Quintana-Rizzo et al. 2021).

The NARW is also a Massachusetts state-listed endangered species, and the Massachusetts Ocean Management Plan established a core habitat Special, Sensitive, or Unique resource area for NARW 0.5 miles (0.8 kilometers) west of the central portion of the Falmouth ECC based on data that identified statistically significant use for feeding by NARW (MassGIS 2020; COP Appendix L1, Figure 3-3; SouthCoast Wind 2023). These critical and core habitat areas do not directly overlap with the Project area. The northeast critical habitat area is located to the north and east of the Massachusetts and Rhode Island Lease Areas, but vessel operations may occur through these areas. Additionally, the Brayton Point ECC runs through approximately 18 miles (29 kilometers) of the corner of the NARW Seasonal Management Area (SMA), off the west coast of Martha's Vineyard, and encompasses NARW migratory routes that may have elevated vessel traffic. To mitigate potential vessel strikes, all vessels 65 feet (19.8 meters) or longer in the NARW SMA are required to reduce speed to no more than 10 nautical miles per hour (9 knots, 16 kilometers per hour) from November 1 through April 30 (COP Appendix L1, Figure 3-1; SouthCoast Wind 2023). Finally, a Biological Important Area for NARW migration runs along the eastern U.S. coastline and includes the Massachusetts and Rhode Island lease areas.

4.9.2.1.4 Sei Whale

Description and Life History

Sei whales (*Balaenoptera borealis*) occur in all the world's oceans and migrate between feeding grounds in temperate and sub-polar regions to wintering grounds in lower latitudes (Kenney and Vigness-Raposa 2010; Hayes et al. 2020). In the Western North Atlantic, most of the population is concentrated in northerly waters along the Scotian Shelf. Sei whales are observed in the spring and summer, utilizing the northern portions of the U.S. Atlantic EEZ as feeding grounds, including the Gulf of Maine and Georges Bank. The highest concentration is observed during the spring along the eastern margin of Georges Bank and in the Northeast Channel area along the southwestern edge of Georges Bank. Passive acoustic monitoring (PAM) conducted along the Atlantic Continental Shelf and Slope in 2004–2014 detected sei whales calls from south of Cape Hatteras to the Davis Strait with evidence of distinct seasonal and geographic patterns. Davis et al. (2020) detected peak call occurrence in northern latitudes during summer indicating feeding grounds ranging from Southern New England through the Scotian Shelf. Sei whales were recorded in the southeast on Blake's Plateau in the winter months, but only on the offshore recorders indicating a more pelagic distribution in this region. Persistent year-round detections in Southern New England and the New York Bight highlight this as an important region for the species (Hayes et al. 2021). In general, sei whales are observed offshore with periodic incursions into more shallow waters for foraging (Hayes et al. 2020).

Sei whales usually travel alone or in small groups of two to five animals, occasionally in groups as large as ten (Hayes et al. 2020). In the North Atlantic, sei whales are known to use the waters of the Gulf of Maine as a feeding ground between spring and early summer (Baumgartner et al. 2011). The prey preferences of sei whales closely resemble those of NARW (Hayes et al. 2020) and may co-occur with NARWs in the spring as both prey on calanoid copepods, particularly *Calanus finmarchicus*, thus, favoring similar feeding grounds with high concentrations of the copepod (NMFS 2011; Prieto et al. 2014).

Between April 2020 and December 2021, there were four sightings of six individual sei whales recorded during HRG surveys conducted within the area surrounding the Lease Area and Falmouth ECC (Milne 2020). Kraus et al. (2016) observed sei whales in the Rhode Island/Massachusetts and Massachusetts WEAs and surrounding areas only between the months of March and June during the 2011–2015 NLPSC aerial survey. The number of sei whale observations was less than half that of other baleen whale species in the two seasons in which sei whales were observed (spring and summer). This species demonstrated a distinct seasonal habitat use pattern that was consistent throughout the study. Calves were observed three times and feeding was observed four times during the Kraus et al. (2016) study. Sei whales were not observed in the Massachusetts WEA and nearby waters during the 2010–2017 AMAPPS surveys (NEFSC and SEFSC 2012, 2013, 2014, 2015, 2016, 2017, 2018). However, there were observations during the 2016 and 2017 summer surveys that were identified as being either a fin or sei whale. Sei whales are expected to be present in the Lease Area and surrounding waters but much less common than the NARW and fin whale.

Marine mammals are organized into groups based on their hearing physiology and sensitivity (NMFS 2018). All mysticetes, including sei whales, are classified as low-frequency cetaceans. This hearing group has a generalized hearing range of 7 hertz to 35 kilohertz.

Status and Population Trend

There are two stocks of sei whales, Nova Scotia stock and Labrador Sea stock. Only the Nova Scotia stock can be found in U.S. waters, and the current abundance estimate for this population is 6,292 derived from recent surveys conducted between Halifax, Nova Scotia, and Florida (Hayes et al. 2020). Population trends are not available for this stock because of insufficient data (Hayes et al. 2020). Sei whales are listed as Endangered under the ESA and by the IUCN Red list (Hayes et al. 2020; IUCN 2020). This stock is listed as strategic and depleted under the MMPA due to its Endangered status (Hayes et al. 2020). Annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 0.8 per year (Hayes et al. 2021). The potential biological removal level (PBR) for this stock is 6.2 (Hayes et al. 2020). Like fin whales, major threats to sei whales include fishery interactions, vessel collisions, contaminants, and climate-related shifts in prey species (Hayes et al. 2020). There are no critical habitat areas designated for the sei whale under the ESA. A Biologically Important Area for feeding for sei whales occurs east of the Lease Area from May through November (LaBrecque et al. 2015).

Distribution and Habitat Use

The sei whale (*Physeter macrocephalus*) is listed as Endangered throughout its range (USFWS 1970). A total of 25 sei whales were observed in the Massachusetts and Rhode Island WEAs and surrounding areas during the NLPS, and observations only occurred between the months of March and June (Kraus et al. 2016). A total of 10 sei whale observations were recorded in the northeast U.S. Atlantic during the 2010–2013 AMAPPS summer/fall shipboard surveys, and 23 sei whale observations were recorded during the 2010–2013 AMAPPS aerial surveys (Palka et al. 2017). No sei whales were observed visually or detected acoustically during surveys of the Project area (AIS Inc. 2020; Mayflower-APEM 2020a–2020m, TerraSond 2019). The MDAT models estimated a monthly average of 0 to 0.05 sei whales occurring per 24,710 acres (10,000 hectares) in the Lease Area (Roberts et al. 2018). This species is generally expected to occur around the continental shelf edge beyond the Lease Area (Hayes et al. 2021 citing Michel 1975; Hayes et al. 2021 citing Michel 1975).

Sei whale modeled density from 1999 to 2020 showed a peak in abundance from April to June, with highest densities in May at approximately 0.16 to 0.25 sei whales/ 29.15 square nautical miles (100 square kilometers) in the Project area. (Roberts et al. 2022c). Sei whale modeled density in the Nantucket Shoals was highest from April to May at 0.040 to 0.63 sei whales/29.15 square nautical miles (100 square kilometers), but also peaked, to a lesser degree, in November and December (Roberts et al. 2022c).

4.9.2.1.5 Sperm Whale

Description and Life History

The sperm whale (*Physeter macrocephalus*) is the largest odontocete, reaching lengths of up to 52 feet (16 meters) and weighing up to 45 tons (NMFS 2023b). Sperm whales are predatory specialists known for hunting prey in deep water. The species is among the deepest diving of all marine mammals. Males have been known to dive 3,936 feet (1,200 meters), whereas females dive to at least 3,280 feet (1,000 meters); both can continuously dive for more than 1 hour. Their diet includes squid, sharks, skates, and fish that occupy deep waters. Sperm whales are the only mid-frequency ESA-listed marine mammal considered and have a generalized hearing range of 150 hertz to 160 kilohertz.

Status and Population Trend

This species is listed as Endangered throughout its range (USFWS 1970). The most recent abundance estimate for the North Atlantic stock is 4,349; between 1,000 to 3,400 Of these individuals occur in U.S. (Hayes et al. 2020). However, this group is likely part of a larger western North Atlantic population, and that population may or may not be distinct from the eastern North Atlantic population (Hayes et al. 2020).

The NLPS recorded limited sightings of sperm whales In the Massachusetts and Rhode Island WEA (Stone et al. 2017; Kraus et al. 2016). Nine sperm whales, traveling alone or in groups of three or four, were observed in 2012 and 2015; six individuals were observed in August and September of 2012, and three individuals were observed in June 2015. The MDAT models estimated a monthly average of 0 to 0.1 sperm whales occurring per 24,710 acres (10,000 hectares) in the Lease Area (Roberts et al. 2018). Sperm whales were not observed visually or detected acoustically during surveys of the Project area (AIS Inc. 2020; Mayflower-APEM 2020a–2020m; TerraSond 2019). Given the location of its general range and lack of recorded sightings in the Massachusetts and Rhode Island WEA, sperm whales are unlikely to co-occur with activities in the Project area.

Distribution and Habitat Use

Sperm whale is expected to occur year-round in deeper waters near the shelf break (Tetra Tech and SES 2018; Tetra Tech and LGL 2019, 2020). Water depths in the Lease Area are generally too shallow for sperm whales. Species densities in the Project area are expected to be low, ranging from 00.04 animals per 29.15 square nautical miles (100 square kilometers) from December through April to 0.01 animals per 29.15 square nautical miles (100 square kilometers) in July (Table 4.9-2).

Modeled density of sperm whales in the Project area from 1998 to 2019 peaked in August and September at approximately 0.16 to 0.25 sperm whale/29.15 square nautical miles (100 square kilometers) and again in October at the same density (Roberts et al. 2022d). Modeled density of sperm whales peaked in June at 0.10 to 0.16 sperm whale/29.15 square nautical miles (100 square kilometers) in the nearby Nantucket Shoals (Roberts et al. 2022d).

4.9.2.2 Sea Turtles

There are four federally listed species of sea turtle likely to occur in the Action Area that have not been discounted from further analysis: green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). The green sea turtle DPS present in the area is the North Atlantic DPS, which is listed as threatened (Seminoff et al. 2015). The loggerhead sea turtles in the area are part of the Northwest Atlantic Ocean DPS and are listed as threatened (Conant et al. 2009). Kemp's ridley and leatherback sea turtles are listed as endangered. As noted in Section 4.8, there is no designated critical habitat for loggerhead sea turtle within the Action Area. Critical habitat has been designated for green and leatherback sea turtles, but it lies outside the Action Area. Critical habitat has not been designated for Kemp's ridley sea turtles. Sea turtle densities are shown in Table 4.9-3.

Table 4.9-3. Sea turtle density estimates within 5 km of the SouthCoast Lease Area

Species	Density (number/100 km2)[1]			
	Spring	Summer	Fall	Winter
Kemp's ridley sea turtle	0.006	0.006	0.006	0.006
Leatherback sea turtle	0.027	0.630[3]	0.873[3]	0.027
Loggerhead sea turtle	0.076	0.206[4]	0.663[4]	0.076
Green sea turtle[2]	0.006	0.006	0.006	0.006

km = kilometer; km^2 = square kilometer
[1] Density estimates are derived from Strategic Environmental Research and Development Program Spatial Decision Support System US Navy Operating Area Density Estimate database within a 5-km buffer of the Project area.
[2] Kraus et al. 2016 did not observe any green sea turtles in the Rhode Island/Massachusetts WEA. Densities of Kemp's ridley sea turtles are used as a conservation estimate.
[3] Densities calculated as averaged seasonal densities from 2011 to 2015 (Kraus et al. 2016).
[4] 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).

There are limited density estimates for sea turtles in the Lease Area. For this assessment, sea turtle densities were obtained from the U.S. Navy Operating Area Density Estimate (NODE) database on the Strategic Environmental Research and Development Program Spatial Decision Support System (SERDP-SDSS) portal (U.S. Navy 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, those were used 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 Massachusetts WEA and Rhode Island/Massachusetts WEAs. Because of this, the more conservative 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 Massachusetts WEA and Rhode Island/Massachusetts 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 thus more conservative.

Kraus et al. (2016) reported only six total Kemp's ridley sea turtle sightings, so the estimates from SERDP-SDSS 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 to provide a conservative estimate.

4.9.2.2.1 Green Sea Turtle

Description and Life History

The green sea turtle is the largest hard-shelled sea turtle, reaching a maximum weight of 350 pounds (150 kilograms) and having a carapace length of up to 3.3 feet (1 meter) (NMFS 2023c). Green sea turtles generally reach sexual maturity between the ages of 25 and 35. Female green sea turtles nest every 2 to 5 years while males breed annually (NMFS 2023c). In the U.S., breeding occurs in late spring and early summer, and nesting occurs in the Southeast between June and September, peaking in June and July (USNRC 2010 citing NOAA 2010; NMFS 2023c). During the nesting season, females come ashore to nest approximately every 2 weeks with clutch sizes of approximately 100 eggs (NMFS 2023c). Hatchlings emerge after approximately 2 months and swim to offshore, pelagic habitats. Young green sea turtles remain in these pelagic habitats for 5 to 7 years before returning to coastal habitats as juveniles (NMFS 2023c).

During their pelagic phase, green sea turtles are omnivorous, foraging in drift communities. Once juveniles return to coastal habitats, they become benthic foragers. As benthic foragers, this species is primarily herbivorous, consuming mostly algae and seagrasses, though sponges and other invertebrates may also contribute to their diet (NMFS 2023c).

Sea turtles possess auditory organs that are adapted for underwater hearing. The hearing range of sea turtles is limited to low frequencies, typically below 1,600 hertz. The hearing range for green sea turtles is from 50 to 1,600 hertz, with peak sensitivity between 200 and 400 hertz underwater and 300 and 400 hertz in the air (Piniak et al. 2016).

Status and Population Trend

Green sea turtles were originally listed under the ESA in 1978. In 2016, the species was divided into 11 DPSs. Green sea turtles found in the Action Area most likely belong to the North Atlantic DPS, which is listed as Threatened (NMFS and USFWS 2016). The status of this DPS was most recently reviewed as part of the 2016 DPS determination and ESA listing. There is no population estimate for the North

Atlantic DPS of green sea turtles. However, nester abundance for this DPS is estimated at 167,234 (Seminoff et al. 2015). All major nesting populations in this DPS have shown long-term increases in abundance (Seminoff et al. 2015).

All sea turtle species in the Action Area, including green sea turtles, are subject to regional, pre-existing threats, including habitat loss or degradation, fisheries bycatch and entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Coastal development, artificial lighting, beach armoring, erosion, sand extraction, vehicle traffic, and sea level rise associated with climate change adversely affect nesting habitat (NMFS and USFWS 2015). Anthropogenic activities, including boating and dredging, degrade seagrass beds, which are used as foraging habitat by this species. Incidental bycatch in commercial and artisanal fisheries, including gill net, trawl, and dredge fisheries, is a major threat to the North Atlantic DPS of green sea turtles (NMFS and USFWS 2015). This species is vulnerable to fibropapillomatosis, a chronic disease that often leads to death (NMFS and USFWS 2015 citing Van Houtan et al. 2014). Green sea turtles are also subject to cold stunning, a hypothermic reaction due to exposure to prolonged cold water temperatures. This phenomenon occurs regularly at foraging locations throughout U.S. waters and leads to mortality in juveniles and adults (NMFS and USFWS 2015).

Distribution and Habitat Use

Green sea turtles inhabit tropical and subtropical waters around the globe. In the U.S., green sea turtles occur from Texas to Maine, as well as the Caribbean. Hatchling and early juvenile sea turtles inhabit open waters of the Atlantic Ocean. Late juveniles and adults are typically found in nearshore waters of shallow coastal habitats (NMFS and USFWS 2007a). Seasonal distribution is governed by water temperatures (NMFS 2018b). As temperatures warm in the spring, sea turtles migrate into southern New England waters. This seasonal movement is reversed as water temperatures cool in the fall and sea turtles migrate to warm waters farther south. In southern New England, juvenile and adult green sea turtles occur in shallow, estuarine waters to forage between May and November (NMFS 2019a).

Green sea turtles have the potential to occur in the Action Area seasonally. This species generally occurs seasonally in the Project area with the highest densities observed between June and November. In the Massachusetts and Rhode Island WEA, no green turtles were identified during the NLPS conducted from 2011–2015. Unidentified juvenile sea turtles encountered in the survey may be either green sea turtles or Kemp’s ridley juveniles (Kraus et al. 2016). There were also no recorded observations of green turtles in northeastern U.S. waters during AMAPPS I surveys or AMAPPS II surveys conducted from 2010–2016 and 2017–2018, respectively (NEFSC and SEFSC 2018; Palka et al. 2017). Four green sea turtle observations were recorded in Sea Turtle Stranding and Salvage Network (STSSN) reports of Massachusetts waters from 2015–2021 (NMFS 2021). Observations included three stranding events in August and October of 2016 and one stranding event in October 2018. Due to a lack of historic and recent records of green sea turtle occurrence in the Massachusetts and Rhode Island WEA and their preference for warmer waters, the species is considered to be uncommon to the Project area, and present primarily in the summer months.

4.9.2.2.2 Kemp’s ridley Sea Turtle

Description and Life History

The Kemp’s ridley sea turtle is a hard-shelled turtle and the smallest of all sea turtle species. The species reaches a maximum weight of 100 pounds (45 kilograms) and grows to 2.3 feet (0.7 meter) in length (NMFS 2023d). Kemp’s ridley sea turtles reach sexual maturity at approximately 13 years of age. This species exhibits synchronized nesting behavior, coming ashore during daylight hours in large groups called arribadas. Females nest every 1 to 3 years and will lay two to three clutches over the course of the nesting season from May to July. Average clutch size is 100 eggs (NMFS 2023d). Hatchlings emerge after 1.5 to 2 months and enter the ocean, traveling to deep, offshore habitats where they will drift in *Sargassum* for 1 to 2 years. After completing their oceanic phase, juvenile Kemp's ridley sea turtles move to nearshore waters to mature (NMFS 2023d).

In their oceanic phase, early life stage Kemp's ridley sea turtles are omnivorous, foraging on floating plants and animals near the surface. Once they recruit to nearshore waters, juveniles and adults consume primarily crabs; mollusks, shrimp, fish, and vegetation also contribute to their diet (Ernst et al. 1994; NMFS 2023d). This species is also known to scavenge on dead fish and discarded bycatch (NMFS 2023d).

Though sea turtles possess auditory organs that are adapted for underwater hearing, their hearing range is limited to low frequencies, typically below 1,600 hertz. The Kemp's ridley hearing range extends from 100 to 500 hertz, with peak sensitivity between 100 and 200 hertz (Bartol and Ketten 2006).

Status and Population Trend

The Kemp's ridley sea turtle is one of the least abundant sea turtle species in the world. This species was listed as Endangered in 1970, as part of a precursor to the ESA (USFWS 1970). The status of this species was most recently assessed for its 5-year status review completed in 2015,[4] and its Endangered status remained unchanged (NMFS and USFWS 2015). In 2012, the population of individuals aged 2 years and up was estimated at 248,307 turtles (NMFS and USFWS 2015 citing Gallaway et al. 2013). Based on hatchling releases in 2011 and 2012, Galloway et al. (2013, as cited in NMFS and USFWS 2015) postulated that the total population size, including turtles younger than 2 years of age, could exceed 1,000,000. However, the number of nests recorded in 2012 was the highest of any year in the monitoring period, and the number of nests declined by almost 50 percent between 2012 and 2014. Therefore, the current population may be significantly lower than the population estimate from 2012 (NMFS and USFWS 2015). The status review also included an updated age-based model to evaluate trends in the Kemp's ridley population. Results of the model indicated that the population is not recovering and suggested there is a persistent reduction in survival and/or recruitment to the nesting population (NMFS and USFWS 2015 citing Heppell. S., Oregon State University, unpublished data 2015).

All sea turtle species in the Action Area, including Kemp's ridley sea turtles, are subject to regional, pre-existing threats, including habitat loss or degradation, fisheries bycatch and entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. This species has the highest fisheries interaction rate of any sea turtle species in the Atlantic and Gulf of Mexico (NMFS and USFWS 2015 citing Finkbeiner et al. 2011). Kemp's ridley continue to be captured and killed at high rates in the Gulf of Mexico shrimp fishery despite mitigation measures (NMFS and USFWS 2015 citing NMFS 2014). Kemp's ridley sea turtles are vulnerable to fibropapillomatosis, but disease frequency is low in this species (NMFS and USFWS 2015). This species is also susceptible to cold stunning.

Distribution and Habitat Use

Kemp's ridley sea turtles primarily inhabit the Gulf of Mexico, though large juveniles and adults travel along the U.S. Atlantic coast. Early life stage sea turtles inhabit open waters of the Atlantic Ocean. Late juvenile and adult Kemp's ridley sea turtles occupy nearshore habitats in subtropical to warm temperate waters, including sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters. As noted for green sea turtles, seasonal distribution is governed by water temperatures (NMFS 2018b). As temperatures warm in the spring, sea turtles migrate into southern New England waters. This seasonal movement is reversed as water temperatures cool in the fall and sea turtles travel to warm waters farther

[4] Another 5-year status review was initiated in June 2021, but this review has not been completed.

south. In southern New England, juvenile Kemp's ridley sea turtles occur in shallow, estuarine waters to forage between May and November (NMFS 2019a).

Kemp's ridley sea turtles could occur in the Action Area seasonally. They are mainly in the Project area during the summer and fall (Kraus et al. 2016). Kemp's ridley sea turtles were rarely observed in the Massachusetts and Rhode Island WEA during the NLPS (Kraus et al. 2016). Six Kemp's ridley sea turtle observations were recorded: one in August 2012 and five in September 2012. No Kemp's ridley sea turtles were observed in the Massachusetts and Rhode Island WEA during the 2009–2015 AMAPPS or 2017–2018 AMAPPS II northeast aerial surveys (NEFSC and SEFSC 2018; Palka et al. 2017). A total of 28 Kemp's ridley sea turtle observations were recorded in STSSN reports of Massachusetts waters from 2021 (NMFS 2021). Observations included 19 stranding observations in the summer and fall of 2015–2019 and 1 incidental capture in October 2017. Two Kemp's ridley sea turtles were observed during visual surveys conducted in the Project area between May and July 2020. One Kemp's ridley sea turtle was observed surfacing in May 2020 and the other Kemp's ridley sea turtle was observed surfacing in July 2020. No Kemp's ridley sea turtles were observed during PSO surveys or aerial surveys conducted for the proposed Project (AIS Inc., 2020; Mayflower-APEM, 2020i).

4.9.2.2.3 Leatherback Sea Turtle

Description and Life History

The leatherback sea turtle is the largest sea turtle species and the only one lacking a hard shell. They can grow to 5.5 feet (1.7 meters) in length and weigh up to 2,200 pounds (998 kilograms) (NMFS and USFWS 2007b; NMFS 2023e). This species reaches sexual maturity between 9 and 29 years of age. The inter-nesting period for leatherback sea turtles is 2 to 3 years. In the U.S., the nesting season extends from March to July. In a single nesting season, females will lay an average of five to seven clutches of eggs with an average clutch size of 100 eggs (Eckert et al. 2015, as cited in NMFS and USFWS 2020a; NMFS 2023e). Hatchlings emerge from the nest after approximately 2 months and disperse into offshore habitats (NMFS and USFWS 2020a). Unlike other sea turtle species, juvenile leatherback sea turtles do not undergo an ontogenetic shift in distribution to shallower habitats and continue to use mid-ocean and continental shelf habitats (NMFS and USFWS 2020a), though older life stages may occur in nearshore waters (NMFS and USFWS 1992).

Leatherback sea turtles often forage in upwelling areas (NMFS and USFWS 2020a citing Saba 2013), though they are known to utilize a variety of habitats for feeding (NMFS and USFWS 2020a citing Robinson and Paladino 2015). Unlike other sea turtle species, leatherbacks have tooth-like cups and sharp jaws, along with backward-pointing spines in their mouth and throat, all adaptations for their unique diet. This species consumes gelatinous prey almost exclusively from the post-hatchling to adult life stage (NMFS 2023e; NMFS and USFWS 2020a citing Salmon et al. 2004).

Though sea turtles possess auditory organs that are adapted for underwater hearing, their hearing range is limited to low frequencies, typically below 1,600 hertz. The leatherback sea turtle's hearing range extends from approximately 50 to 1,200 hertz, with peak sensitivity between 100 and 400 hertz (Piniak et al. 2012a & Piniak et al. 2012b).

Status and Population Trend

Similar to Kemp's ridley sea turtle, the leatherback sea turtle was listed as Endangered in 1970, as part of a precursor to the ESA. In 2017, NMFS recognized that the Northwest Atlantic subpopulation of leatherback sea turtles may constitute a DPS and began a status review for the species (NMFS and USFWS 2017). The status review indicated that seven subpopulations, including the Northwest Atlantic, meet the criteria for listing as DPSs. However, as all seven DPSs would be considered endangered and the species is currently listed as endangered throughout its range, NMFS and the USFWS determined that the listing of individual DPSs was not warranted (NMFS and USFWS 2020). Abundance of leatherback sea turtle was most recently evaluated in the 2020 review undertaken to determine whether to list separate DPSs of leatherbacks under the ESA. Among subpopulations of leatherback sea turtle, abundance estimates for nesting females range from less than 100 to nearly 10,000 (NMFS and USFWS 2020a). Recent data indicate that the abundance of nesting leatherback females has declined rapidly in several subpopulations. In the Northwest Atlantic, the abundance of nesting females is currently estimated at 20,569. This population is currently exhibiting an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020a).

This species is subject to regional, pre-existing threats, including habitat loss or degradation, fisheries bycatch and entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Most leatherback nesting beaches have been severely degraded by anthropogenic activities, including coastal development, beach erosion, placement of erosion control and stabilization structures, and artificial lighting (NMFS and USFWS 2020a). Fisheries bycatch is considered the primary threat to Northwest Atlantic leatherback sea turtles (NMFS and USFWS 2020a).

Distribution and Habitat Use

Leatherback sea turtles are found in the Atlantic, Pacific, and Indian Oceans (NMFS 2023e). This species can be found throughout the western North Atlantic Ocean as far north as Nova Scotia, Newfoundland, and Labrador (Ernst et al. 1994). While early life stages prefer oceanic waters, adult leatherback sea turtles are generally found in mid-ocean, continental shelf, and nearshore waters (NMFS and USFWS 1992). This species displays a marked migration pattern, entering the southern New England waters in spring and remaining through the summer months (Shoop and Kenney 1992).

Leatherback sea turtles could occur in the Action Area seasonally. Species densities in the Project area are highest in the summer and fall with a few sightings in the spring. Leatherback turtles were seen more frequently than other sea turtle species in the Massachusetts and Rhode Island WEA during the NLPS (Kraus et al. 2016). Leatherback sea turtles were also the primary sea turtle species identified during follow-up surveys conducted in 2018–2019, though these sightings mainly occurred south of Nantucket Island (O’Brien et al. 2021). The majority of observations occurred in the summer and fall, followed by two sightings in spring and none in the winter. No leatherback sea turtles were observed during PSO surveys or aerial surveys conducted for the proposed Project (AIS Inc., 2020; Mayflower-APEM, 2020i).

4.9.2.2.4 Loggerhead Sea Turtle

Description and Life History

The loggerhead sea turtle is a large, hard-shelled sea turtle that can reach 3 feet (1 meter) in carapace length and weigh up to 250 pounds (113 kilograms) (NMFS 2023f). Adults reach sexual maturity at approximately 35 years of age. This species nests every 2 to 3 years on ocean beaches. Nesting occurs in the southeastern U.S. between April and September, peaking in June and July (Hopkins and Richardson 1984; Dodd 1988). During the nesting season, females will lay two to three clutches of eggs, with each clutch containing 35 to 180 eggs. After approximately 1.5 to 2 months, hatchlings emerge from the nests (Hopkins and Richardson 1984). Hatchlings travel offshore and remain in the open ocean until they return to coastal and continental shelf waters as juveniles. Loggerheads continue to use the same coastal and oceanic waters through adulthood.

Juvenile loggerheads are pelagic and benthic foragers, consuming a variety of prey, including crabs, mollusks, jellyfish, and plants (NMFS and USFWS 2008). Once they reach the subadult life stage and spend more time in coastal areas, loggerhead sea turtles forage in hard bottom habitats, feeding on mollusks, decapod crustaceans, and other benthic invertebrates (NMFS and USFWS 2008).

Though sea turtles possess auditory organs that are adapted for underwater hearing, their hearing range is limited to low frequencies, typically below 1,600 hertz. The loggerhead sea turtle's hearing range extends from approximately 50 to 100 hertz up to 800 to 1,120 hertz (Martin et al. 2012).

Status and Population Trend

Loggerhead sea turtle is the most abundant sea turtle species in U.S. waters. The loggerheads found in the Action Area belong to the Northwest Atlantic DPS. This DPS was listed as threatened in 2011 (NMFS and USFWS 2011). The status of the Northwest Atlantic Ocean DPS of loggerhead sea turtles was last assessed as part of the 2011 ESA listing. The most recent population estimate for the Northwest Atlantic continental shelf, calculated in 2010 is 588,000 juvenile and adult loggerhead sea turtles (NEFSC and SEFSC 2011). The 2011 status review included a review of previous nesting analyses that included data through 2007 along with more recent data. Considering previous nesting data with more recent data, the nesting trend for this DPS from 1989 to 2010 was slightly negative. However, the rate of decline was not significantly different from zero (NMFS and USFWS 2011). Though nesting experienced a low in 2007, there was a substantial increase in 2008, and nesting in 2010 was the highest observed since 2000. The recovery units for the Northwest Atlantic Ocean DPS have shown no trend or an increasing trend in nest abundance; however, these recovery units have not met their recovery criteria for annual increases in nest abundance (Bolten et al. 2019).

All sea turtle species in the Action Area, including loggerhead sea turtles, are subject to regional, pre-existing threats, including habitat loss or degradation, fisheries bycatch and entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Coastal development, artificial lighting, and erosion control structures negatively affect nesting habitat and pose a significant threat to the persistence of the Northwest Atlantic DPS of loggerhead sea turtles (NMFS and USFWS 2010). Fisheries bycatch, particularly in gillnet, trawl, and longline fisheries, is also a significant threat to this DPS. Vessel strikes have become more common for loggerhead sea turtles. Though this species is vulnerable to fibropapillomatosis, prevalence is low in loggerheads. Loggerhead sea turtles are also vulnerable to cold stunning, but cold stunning is not a major source of mortality for this species (NMFS and USFWS 2010).

Distribution and Habitat Use

Loggerhead sea turtles inhabit nearshore and offshore habitats throughout the world (Dodd 1988). This species occurs throughout the Northwest Atlantic as far north as Newfoundland (NMFS 2023f). U.S. continental shelf waters in southern New England have been identified as foraging habitat for juveniles (NMFS 2023f). As with other sea turtle species, hatchling and early juveniles inhabit open waters of the Atlantic Ocean. As they mature, juveniles move from open water habitats into near-shore coastal areas where they forage and mature into adults. As noted for green and Kemp's ridley sea turtles, seasonal distribution of loggerheads is governed by water temperatures (NMFS 2018b). As temperatures warm in the spring, sea turtles migrate into southern New England waters. This seasonal movement is reversed as water temperatures cool in the fall and sea turtles migrate to warm waters farther south. In the southern New England, juvenile and adult loggerhead sea turtles, regularly occur in shallow, estuarine waters to forage between May and November (NMFS 2019a).

Loggerhead sea turtles could occur in the Action Area seasonally. The NLPS recorded 78 loggerhead sea turtle individuals in the Massachusetts and Rhode Island WEA (Kraus et al. 2016); 2 observations were recorded in the spring, 31 in the summer, and 45 in the fall (which all occurred in the month of September). There were no loggerhead sea turtles observed in the winter. In the Massachusetts and Rhode Island WEA, two Loggerheads were observed during follow-up surveys conducted in 2018–2019

(O'Brien et al. 2021) and one was observed in surveys conducted in 2020-2021 (O'Brien et al. 2022). Recorded observations were spread evenly across the Massachusetts and Rhode Island WEA in the summer, and some individuals were observed in the Project area; there was a higher concentration of individuals in the Project area in September, likely due to turtles migrating south through the Massachusetts and Rhode Island WEA. Loggerhead sea turtle observations were recorded just northeast of the Massachusetts and Rhode Island WEA in the spring and fall.

4.9.2.3 Fish

One ESA-listed fish species, Atlantic sturgeon (*A. oxyrinchus oxyrinchus*), is likely to occur in the Action Area and has not been discounted from further analysis. There is designated critical habitat for this species in the Action Area, specifically for the Chesapeake and Carolina DPSs, but this critical habitat is discounted from further analysis due to the low likelihood of use of Project ports that overlap these critical habitats as noted in Section 4.8.2.

4.9.2.3.1 Atlantic Sturgeon

Description and Life History

Atlantic sturgeon is an anadromous species. This species is benthic-oriented and large-bodied, reaching a maximum total length of approximately 13.1 feet (4 meters) (Bain 1997). Atlantic sturgeon is also long-lived, reaching a maximum age of approximately 60 years (Gilbert 1989). Males reach sexual maturity at about 12 years of age, and females spawn for the first time at 15 years of age or older (Able and Fahay 2010; Bain 1997). Atlantic sturgeon spawn interannually in riverine systems (i.e., not offshore), and spawning periods vary between sexes. Males spawn every 1 to 5 years while females spawn every 2 to 5 years (Vladykov and Greeley 1963). During spawning, females deposit eggs over hard substrate (e.g., gravel, cobble, and rock) where they are fertilized externally by the males.

Atlantic sturgeon eggs are adhesive and remain attached to hard substrate on the upstream spawning grounds during incubation. Larvae hatch approximately 4 to 6 days after fertilization (ASSRT 2007; Mohler 2003). Yolk-sac larvae remain closely associated with benthic substrate on spawning areas (Bain et al. 2000). Yolk-sac absorption occurs over 8 to 12 days. Post yolk-sac larvae are active swimmers but continue to remain closely associated with benthic substrate for approximately 2 weeks following yolk-sac absorption (ASMFC 2012). Following yolk-sac absorption, juvenile Atlantic sturgeon emerge from the substrate to begin foraging and start their downstream migration (Kynard and Horgan 2002). Juveniles generally remain in their natal river for at least 2 years (ASMFC 2012). Subadults make their first migration into marine habitats at 4 to 8 years of age (ASSRT 2007). Prior to reaching sexual maturity, subadults return to their natal rivers to forage in the spring and summer months. Adult Atlantic sturgeon spend a majority of their time in marine habitats, often undertaking long-distance migrations along the Atlantic coast, and return to freshwater habitats in their natal rivers to spawn (Bain 1997).

Atlantic sturgeon undergo an ontogenetic shift in diet as they age. Post yolk-sac larvae feed on plankton then transition to benthic omnivores at older life stages. Juvenile diets include aquatic insects and other invertebrates. Subadults and adults consume bivalves, gastropods, amphipods, isopods, polychaete and oligochaete worms, and demersal fish (Able and Fahay 2010; ASSRT 2007; Bigelow and Schroeder 1953). Foraging studies indicate that larger Atlantic sturgeon have a strong preference for polychaetes; these data also show that isopods make up a larger portion of Atlantic sturgeon diets than amphipods (Dadswell 2006; Guilbard et al. 2007; Haley 1999; Johnson et al. 1997; Krebs et al. 2017; McLean et al. 2013; Savoy 2007). Though Atlantic sturgeon are known to forage on small fish, including sand lance (*Ammodytes* spp.), Atlantic tomcod (*Microgadus tomcod*), and American eel (*Anguilla rostrata*), the importance of fish in Atlantic sturgeon diet may vary with body size and location (Guilbard et al. 2007; Johnson et al. 1997; Krebs et al. 2017; McLean et al. 2013; Scott and Crossman 1973).

There are few published studies on the hearing ability of sturgeon. A study on the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon (*Acipenser fulvescens*) found that both species responded to sounds ranging from 100 to 500 hertz (Lovell et al. 2005). Based on preliminary physiological analysis, Atlantic sturgeon may be able to detect sounds from below 100 hertz to perhaps 1,000 hertz and should possess the ability to localize sound sources (Meyer and Popper unpublished cited in Popper 2005). As the sturgeon family, Acipenseridae, have a well-developed inner ear that functions independently of the swim bladder, it seems that sturgeon primarily depend on their ears for hearing. Although no data are available on Atlantic sturgeon vocalizations, other sturgeon have been found to produce sounds (Popper 2005).

Status and Population Trend

Atlantic sturgeon in the U.S. are divided into five DPSs: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. In 2012, the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered, and the Gulf of Maine DPS was listed as threatened (NMFS 2012a, 2012b). While the DPSs considered in this BA are the Chesapeake Bay DPS and Carolina DPS, Atlantic sturgeon are known to migrate across estuarine and marine environments with extensive movements up and down the U.S. East Coast and into Canadian waters and frequently form mixed-stock aggregations in non-natal habitats, therefore, Atlantic sturgeon encountered within the Action Area may originate from any of the five DPSs (Kazyak et al. 2021).

Chesapeake Bay DPS

The Chesapeake DPS is composed of all Atlantic sturgeon spawned in Chesapeake Bay watersheds as well as coastal watersheds from Fenwick Island at the Delaware-Maryland border to Cape Henry, Virginia. In the most recent 5-year status review, NMFS estimated the oceanic population abundance of the Chesapeake DPS at 8,811 fish (NMFS 2022c). This DPS has not shown any significant trend in abundance since 1998 and is depleted relative to historic levels (ASMFC 2017). Similar to the New York Bight DPS, impaired water quality, habitat disturbance, bycatch, and vessel strikes pose threats to the Chesapeake DPS (NMFS 2022c).

Carolina DPS

Atlantic sturgeon spawning for the Carolina DPS has been verified to occur in the Roanoke River and is suspected to occur in the Tar-Pamlico, Neuse, and Cape Fear Rivers in North Carolina and the Pee Dee and Cooper Rivers in South Carolina (ASMFC 2017). While long term data on relative sturgeon abundance in the Carolina DPS is scarce, biomass and abundance status for the coastwide population of Atlantic sturgeon including the Carolina DPS are considered depleted relative to historical levels (ASMFC 2017). Poor habitat quality, specifically exceedances of temperature and dissolved oxygen tolerances of sturgeon, poses a major threat to the development and survival of all Atlantic sturgeon life stages in the Carolina DPS (NMFS 2017b). Habitat disturbance from dredging also adds to this threat when hard substrates that are considered part of the sturgeon critical habitat are altered or removed.

Distribution and Habitat Use

Atlantic sturgeon are distributed from Labrador, Canada, to Cape Canaveral, Florida. In southern New England, spawning adults migrate upstream during April and May (Able and Fahay 2010). After spawning, females return to coastal waters within 4 to 6 weeks. Males may remain in freshwater habitats into the fall (Able and Fahay 2010).

Juvenile, subadult, and adult Atlantic sturgeon are expected to occur seasonally in the Action Area. Generally, this species is expected to migrate in spring from marine habitats to inshore coastal waters and return to marine habitats in the fall. Very few Atlantic sturgeon have been captured as bycatch in fisheries or in fisheries-independent surveys in the Massachusetts Wind Energy Area (Stein et al. 2004; Dunton et al. 2010).

4.10 Climate Change Considerations

Climate change is an ongoing and developing phenomenon that has been shown to affect marine ecosystems. Warming sea temperature is a key feature of global climate change caused by atmospheric greenhouse effects from global greenhouse gas emissions including carbon dioxide (CO2). Warming water temperatures, in combination with sea level rise, could affect ESA-listed species in the Action Area. Warming and sea level rise could affect these species through increased storm frequency and severity, altered habitat/ecology, changes in prey distribution, altered migration patterns, increased disease incidence, increased erosion and sediment deposition, and development of protective measures (e.g., seawalls and barriers). Increased storm severity or frequency may result in increased energetic costs for marine mammals, particularly for young life stages, reducing individual fitness. Altered habitat/ecology associated with warming has resulting in northward distribution shifts for some prey species (Hayes et al. 2021); marine mammals are altering their behavior and distribution in response to these alterations (Davis et al. 2017, 2020; Hayes et al. 2020, 2021). Warming is also expected to influence the frequency of marine mammal diseases. Warming and sea level rise could lead to changes in sea turtle distribution, habitat use, migratory patterns, nesting periods, nestling sex ratios, nesting habitat quality or availability, prey distribution or abundance, and availability of foraging habitat (Fuentes and Abbs 2010; Janzen 1994; Newson et al. 2009; Witt et al. 2010). Northward shifts in fish communities, including demersal finfish and shellfish, have been documented to occur concurrently with rises in sea surface temperature (Gaichas et al. 2015; Hare et al. 2016; Lucey and Nye 2010).

Ocean acidification is another major problem caused by the release of anthropogenic CO2 into the atmosphere (Doney et al. 2020). The ocean serves as a major sink for anthropogenic CO2 (Doney et al. 2020). Once deposited in seawater, CO2 lowers pH levels, increasing its acidity. Ocean acidification may have negative impacts on zooplankton and benthic organisms, especially the many species that have calcareous shells or exoskeletons (e.g., shellfish, copepods) by reducing the growth of these species (PMEL 2020). Ocean acidification may affect ESA-listed marine mammal, sea turtle, and fish species through negative effects on their prey.

Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on ESA-listed species of marine mammals, sea turtles, and fish.

5. Effects of the Proposed Action

The effects of the Proposed Action are analyzed in this section based on the PDE described in Section 3. Effects of the Proposed Action include all consequences to ESA-listed species or designated critical habitat caused by the Proposed Action across all phases of the Project, including pre-construction, construction, O&M, and decommissioning. This includes consequences of other activities that would not occur but for the Proposed Action that are reasonably certain to occur. Effects are considered relative to the likelihood of species' exposure to each effect and the biological significance of that exposure. Biological significance is evaluated based on the extent and duration of exposure relative to established effects thresholds or relative to baseline conditions described in Section 4. Effects evaluated for the Proposed Action, including impacts from *Underwater Noise* (Sections 5.2), *Other Noise Impacts* (Section 5.3), *Effects of Vessel Traffic* (Section 5.4), *Habitat Disturbance and Modification* (Section 5.5), *Fisheries and Habitat Surveys and Monitoring* (Section 5.6), *Air Emissions* (Section 5.7), *Port Modifications* (Section 5.8), *Repair and Maintenance Activities* (Section 5.9), and *Other Effects* (Sections 5.10). Each of these impacts is evaluated separately for ESA-listed marine mammals, sea turtles, and fish, along with the mitigation, monitoring, and reporting measures as proposed in the ITR (Table 3.3-1, SouthCoast Wind MMPA Incidental Take Regulations Application, [LGL 2024]) and agency-proposed mitigation measures (Table 3.3-2) designed to minimize the impacts of the Proposed Action where applicable.

5.1 Determination of Effects

Based on the analysis of the methods described in this section, potential effects from the proposed Project were determined using the criterion described as follows:

The term "consequences," was introduced to the ESA to replace "direct" and "indirect" effects in 2019. Consequences are a result or effect of an action on ESA species. NMFS uses two criteria to identify the ESA-listed species and designated critical habitat that are **not likely to be adversely affected** by the Proposed Action.

The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If NMFS concludes that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, they must also conclude that the species or designated critical habitat is **not likely to be adversely affected** by those activities.

The second criterion is the probability of a response given exposure. An ESA-listed species or designated critical habitat that co-occurs with a stressor of the action but is not likely to respond to the stressor is also **not likely to be adversely affected** by the Proposed Action.

A determination for each species and designated critical habitat was made based on an analysis of potential consequences from each identified stressor. One of the following three determinations, as defined by the ESA, has been applied for listed species and critical habitat that have potential to be affected by the Project: no effect; may affect, not likely to adversely affect; may affect, likely to adversely affect.

The probability of an effect on a species or designated critical habitat is a function of exposure intensity and susceptibility of a species to a stressor's effects (i.e., probability of response).

- ***No effect*** – This determination indicates that the proposed Project would have no effects, positive or negative, on species or designated critical habitat. Generally, this means that the species or critical habitat would not be exposed to the proposed Project and its environmental consequences.
- A ***may affect, not likely to adversely affect*** determination would be given if the Project's effects are wholly beneficial, insignificant, or discountable.
    - o *Beneficial* effects have an immediate positive effect without any adverse effects on the species or habitat.
    - o *Insignificant* effects relate to the size or severity of the effect and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. *Insignificant* is the appropriate effect conclusion when plausible effects are going to happen but will not rise to the level of constituting an adverse effect.
    - o *Discountable*[5] effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did affect a listed species), but it is extremely unlikely to occur (USFWS and NMFS 1998).
- A ***may affect, likely to adversely affect*** determination occurs when the proposed Project may result in any adverse effect on a species or its designated critical habitat. In the event that the Project may have beneficial effects on listed species or critical habitat, but is also likely to cause some adverse effects, then the proposed Project **may affect, likely to adversely affect**, the listed species.

5.2 Underwater Noise

Exposure to high levels of underwater noise can affect ESA-listed species in the Action Area leading to the ESA-level takes of harm and/or harass. The Proposed Action would generate temporary noise during pre-construction surveys, construction, and decommissioning phases while long-term noise would be generated during the O&M phase. Underwater noise sources associated with the Proposed Action include impact pile driving, vibratory pile driving, geotechnical and geophysical surveys, cable laying, dredging, UXO detonation, vessel activity, and WTG operations. These activities increase sound levels in the environment and may affect ESA-listed species in the Project area and Action Area. The sections that follow provide an overview of available information on ESA-listed species' hearing, the thresholds applied, and the results of the underwater noise modeling conducted. Discussions on the impact consequences for each potential underwater noise-generating activity for the Project are provided along with a summary of overall underwater noise effects to ESA-listed species in subsequent sections.

5.2.1 Underwater Noise Overview

Underwater sound can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as pressure waves. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding receiving environment. The amount by which the sound levels decrease between a source and a receiver is called transmission loss. The amount of transmission

[5] When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with the ESA regulatory definition of "effects of the action."

loss that occurs depends on the source-receiver separation, the frequency of the sound, the properties of the water column, and the properties of the seafloor. Underwater sound levels are expressed in decibels (dB), which is a logarithmic ratio relative to a fixed reference pressure of 1 micropascal (μPa) (equal to 10^{-6} pascals [Pa] or 10^{-11} bar).

The efficiency of underwater sound propagation allows marine mammals to use underwater sound as a method of communication, navigation, prey detection, and predator avoidance (Richardson et al. 1995; Southall et al. 2007). Anthropogenic (i.e., human-introduced) noise has gained recognition as a potential stressor for marine mammals because of their reliance on underwater hearing for maintenance of these critical biological functions (Richardson et al. 1995; Ketten 1998). Underwater noise generated by human activities can often be detected by marine animals many kilometers from the source. With increasing distance from a noise source, potential acoustic impacts can range from physiological injury to permanent or temporary hearing loss, behavioral changes, and acoustic masking (i.e., communication interference). All the above impacts have the potential to induce stress on marine animals in their receiving environment (Erbe 2013).

Anthropogenic noise sources can be categorized generally as impulsive (e.g., impact pile driving, explosions) or non-impulsive (e.g., vibratory pile-driving, vessel noise), especially in the context of evaluating noise-induced hearing loss. Sounds from moving sources such as ships are continuous noise sources, although transient relative to the receivers. Impulsive noises are characterized by broad frequencies, fast rise time, short durations, and a high peak sound pressure (Finneran 2016). Non-impulsive noise is better described as a steady-state noise source. For auditory effects, underwater noise is less likely to disturb or injure an animal if it occurs at frequencies at which the animal cannot hear well. The importance of sound components at particular frequencies can be scaled by frequency weighting relative to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998; Nedwell et al. 2007). Regulatory-defined acoustic thresholds used for the purpose of predicting the extent of injury and behavioral disturbance for various marine fauna, including marine mammals, sea turtles, and fish, and the subsequent management of these impacts have recently been revised to account for the duration of exposure, incorporation of new hearing and temporary threshold shift (TTS) data, and the differences in hearing acuity in various marine animal species groups (Finneran 2016; Finneran 2017; NMFS 2018b).

Shock waves associated with underwater detonations (e.g., UXOs) can induce both auditory effects (permanent threshold shift [PTS] and TTS) and non-auditory physiological effects, including mortality and direct tissue damage known as primary blast injury. The magnitude of the acoustic impulse (which is the integral of the instantaneous sound pressure) of the underwater blast causes the most common injuries, and therefore its value is used to determine if mortality or non-auditory injury occurs (U.S. Navy 2017a).

The auditory, non-auditory, and behavioral response thresholds used in this BA are:

- Auditory thresholds for marine mammals (all activities): NMFS (2018b). Marine Mammal Acoustic Technical Guidance (2018) Revision to Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0), Office of Protected Resources, NOAA Technical Memorandum NMFS-OPR-59, April 2018.
- Non-auditory thresholds for marine mammals and sea turtles (UXO detonations): U.S. Department of the Navy (U.S. Navy) (2017a). Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III), June 2017. Thresholds for gastrointestinal and lung injury, and mortality for marine mammals and sea turtles due to explosive pressure based on impulse and peak pressure.
- Thresholds for fish (impact pile driving): Fisheries Hydroacoustic Working Group (FHWG) (2008). Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities.

- Thresholds for fish (quantitative and qualitative; all activities): Popper et al. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014.
- Injury, impairment, and behavioral response thresholds for sea turtles developed for use by the U.S. Navy (Finneran et al. 2017) based on exposure studies (e.g., McCauley et al. 2000). Dual criteria (PK for peak sound pressure level and SEL for cumulative sound exposure level) have been suggested for permanent threshold shift (PTS), along with auditory weighting functions published by Finneran et al. (2017) used in conjunction with SEL thresholds for PTS for impulsive sounds.

Potential adverse auditory effects to marine mammals from Project-generated underwater noise includes PTS, TTS, behavioral disruption, and masking; potential non-auditory effects to marine mammals from Project-generated shock waves (from UXO detonations only) includes mortality, lung injury, and gastrointestinal injury.

The extent and severity of auditory, non-auditory, and behavioral effects from Project-generated underwater noise is dependent on the timing of activities relative to species occurrence, the type of noise impact, and species-specific sensitivity. To support the underwater noise assessment for the Project, SouthCoast Wind conducted Project-specific underwater noise modeling for the following Project activities: impact pile driving, vibratory sheet pile driving, UXO detonations, and HRG surveys. A summary of the reports used in the BA are provided below:

- Denes, S.L., M.J. Weirathmueller, E.T. Küsel, K.E. Limpert, K.E. Zammit, and C.D. Pyć. 2021. Technical Report: Underwater Acoustic Modeling of Construction Sound and Animal Exposure Estimation for Mayflower Wind Energy LLC. Document 02185, Version 3.0 Revision 1. Technical report by JASCO Applied Sciences for AECOM.
- Limpert, K.E., S.C. Murphy, E.T. Küsel, H.P. Wecker, S.G. Dufault, K.E. Zammit, M.J. Weirathmueller, M.L. Reeve, and D.G. Zeddies. 2024. SouthCoast Wind: Additional Underwater Acoustic Modeling Scenarios. Document 02772, Version 2.2. Technical report by JASCO Applied Sciences for LGL
- Li, Z. and S.L. Denes. 2020. Distances to Acoustic Thresholds for High Resolution Geophysical Sources: Mayflower Wind. Document 2239, Version 1.0. Technical memorandum by JASCO Applied Sciences for Mayflower Wind.
- Hannay, D.E. and M. Zykov. 2022. Underwater Acoustic Modeling of Detonations of Unexploded Ordnance (UXO removal) for Mayflower Wind Farm Construction. Document 02604, Version 4.2. Report by JASCO Applied Sciences for Mayflower Wind.

Definition of Take, Harm, and Harass

Under Section 3 of the ESA, "take" of an animal is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct". NMFS categorizes two forms of take: lethal and sublethal take. Lethal take is expected to result in immediate, imminent, or delayed but likely mortality. Sublethal take is when effects of the action are below the level expected to cause death and falls under three categories: mortality, serious injury, and harassment. Harm, as defined by regulation (50 CFR §222.102), includes acts that actually kill or injure wildlife and acts that may cause significant habitat modification or degradation that actually kill or injure fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Thus, for sublethal take, NMFS is concerned with harm that does not result in mortality but is still likely to injure an animal.

NMFS has not defined “harass” under the ESA by regulation. However, on October 21, 2016, NMFS 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 2016d). This BA relies on this definition of “harass” when assessing effects to all ESA-listed species except marine mammals.

For marine mammal species, prior to the issuance of the October 21, 2016, guidance, consultations that involved NMFS Permits and Conservation Division’s authorization under the MMPA relied on the MMPA definition of harassment. Under the MMPA, harassment is defined as follows.

- Level A: 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: Any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but that does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 USC 1362).

NMFS October 21, 2016, guidance states that the “interim ESA harass interpretation does not specifically equate to MMPA Level A or Level B harassment but shares some similarities with both levels in the use of the terms ‘injury/injure’ and a focus on a disruption of behavior patterns. NMFS has not defined ‘injure’ for purposes of interpreting Level A and Level B harassment but in practice has applied a physical test for Level A harassment” (NMFS 2016d). However, the underwater noise modeling used to estimate take numbers for marine mammals does correspond to MMPA definitions of Level A and B harassment. Therefore, in this effects analysis, estimates of Level A harassment were considered to be instances of potential harm (e.g., UXO detonations) or physiological impacts associated with PTS (auditory injury not leading to serious injury or mortality and other non-auditory injury not leading to serious injury or mortality), whereas Level B harassment in this analysis may involve physiological impacts associated with TTS or behavioral disturbance. Level B harassment may involve a wide range of behavioral responses, including, but not limited to, avoidance, changes in calling or dive patterns, or disruption of feeding, migrating, or reproductive behaviors. Level B harassment may or may not constitute harm under the ESA definition of “significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering,” depending on the nature of the effects.

5.2.2 Impact and Vibratory Pile Driving

Impact and vibratory pile driving would occur during construction to install WTG and OSP foundations (Section 3.1.2.3). Impact pile driving generates intense, impulsive underwater noise while vibratory pile driving generates non-impulsive, continuous underwater noise that may result in physiological or behavioral effects in aquatic species. The severity of the effect is dependent on the received sound level (i.e., the sound level to which the organism is exposed), which is a function of the sound level generated by the noise source, the distance between the source and the organism, and the duration of sound exposure.

To determine distances (exposure and acoustic ranges) to the established PTS and disturbance thresholds for marine mammals, sea turtles, and fish, acoustic source level, propagation, and animal movement modeling of the pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences (Limpert et al. 2024). Note that unlike marine mammals and sea turtles for which animal movement modeling was performed, fish were considered static (not moving) receivers, therefore, only the acoustic ranges to fish regulatory thresholds were calculated. Sound generated during pile driving was modeled by characterizing the sound produced at the pile and then calculating how the sound propagates within the surrounding water column. Two types of piles representing the largest of potential foundation diameters in the PDE were modeled: 52-foot (16-meter) diameter monopiles and 15-foot (4.5-meter) diameter pin piles as part of the four-legged jacket foundations. The acoustic modeling also included assumptions about the potential effectiveness of one or more noise abatement systems (NAS) in reducing sounds propagated into the surrounding marine environment. Several recent studies summarizing the effectiveness of NAS have shown that broadband sound levels are likely to be reduced by anywhere from 7 to 17 dB, depending on the environment, pile size, and the size, configuration and number of systems used (Buehler et al. 2015; Bellmann et al. 2020a). The use of one or more NAS is reasonably expected to achieve greater than 10 decibels broadband attenuation of impact and vibratory pile driving sounds, therefore NAS performance of 10-decibel broadband attenuation was assumed when calculating ranges to threshold levels and potential exposures used in developing the total requested take. For comparison, exposure-based radial distance estimates assuming no attenuation, 6-decibel attenuation, and 15-decibel attenuation were also calculated with the full results available in the MMPA ITA application and included as Appendix A (LGL 2024).

Sound transmission depends on many environmental parameters such as the sound speeds in water and substrates, the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness), and the make and energy of the hammer. In the modeling study, sound fields from the installation of piles were simulated using a theoretical 6,600- kilojoule impact hammer for monopiles and a Menck MHU 3500S impact hammer for pin piles. The sound fields were then modeled at two representative locations (L01 and L02) in the Project area (Figure 5.2-1). The locations were selected to represent the acoustic propagation environment with representative coverage of water depths within the Lease Area. At location L01, the water depth is approximately 174 feet (53 meters), while at location L02, the water depth is approximately 125 feet (38 meters). Decidecade spectral source levels at 10 meters from the source for each pile type, hammer energy, and modeled location using average summer and winter sound speed profiles are provided in the MMPA ITA application (LGL 2024).

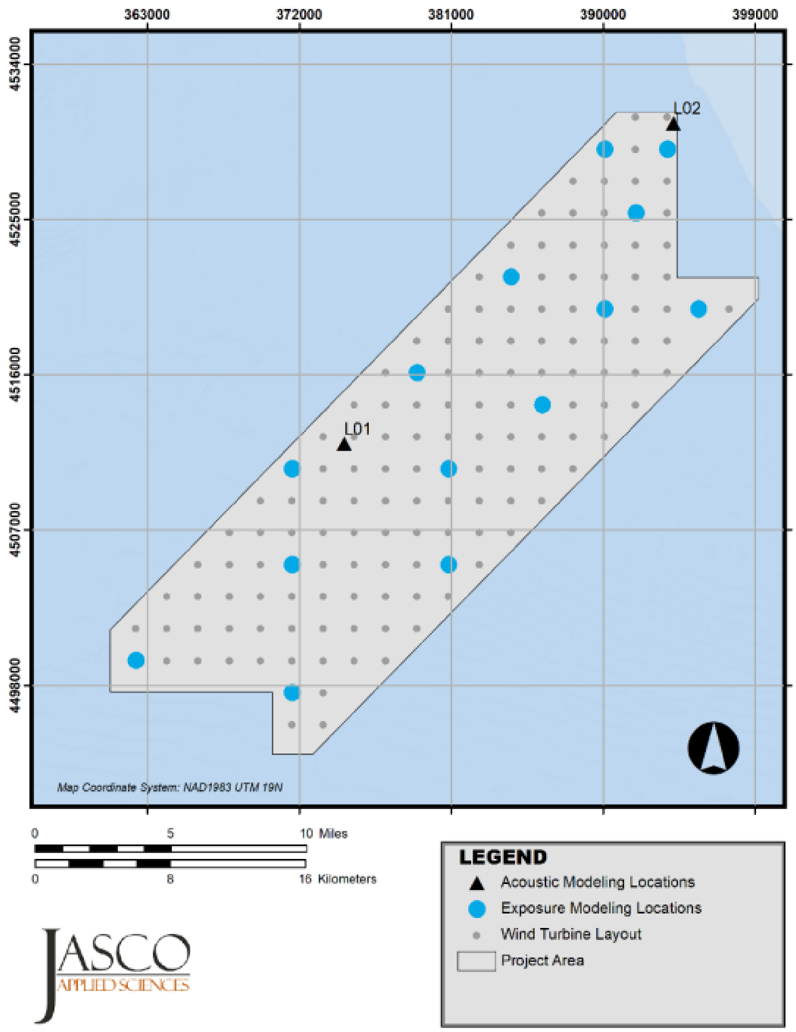


Figure 5.2-1. Locations of acoustic propagation and animal exposure modeling for WTG and OSP foundation installation

Acoustic and animal exposure modeling was also performed for different construction scenarios. The primary assumptions used in the modeling of each scenario are summarized in Table 5.2-1 and listed below. Year 1 (corresponding to Project 1) assumes WTG foundation installations will use impact pile driving only (no vibratory pile driving). Year 2 (corresponding to Project 2) assumes WTG foundation installations will use either a combination of vibratory and impact pile driving or impact pile driving only. The modeling assumes that WTG foundation installation will progress in a sequential manner, whereby one foundation is installed completely before installation of the next foundation begins. For jacket foundations, the jacket piles are installed sequentially and all piles for a single foundation are installed before installation of the next foundation begins. The modeling also includes concurrent installation of WTG foundations and OSP foundations whereby installation of the two foundation types occurs at the same time. For these cases, only impact pile driving was assumed. Project-level exposure estimates used average sound speed profiles for “summer” months (April – November) and “winter” months (December – March). Installation of WTGs was modeled between May through December for Year 1 and Year 2. SouthCoast Wind does not intend to conduct pile driving activity from January 1 through May 14 each year.

1. **Year 1 – WTG monopiles, or WTG piled jackets, impact piling only with concurrent OSP installations**
   a. Scenario 1 – Sequential installation of 68 WTG monopile foundations (9/16 meters; assuming 1 pile per day for 44 of the monopiles and 2 piles per day for 24 of the monopiles) plus concurrent installation of OSP jacket (12, 4.5 meter pin piles) and 3 WTG monopile (9/16 m; 1/day) foundations for a total of 71 WTG monopiles and 1 OSP jacket foundation.
   b. Scenario 2 – Sequential installation of 81 WTG jacket foundations (1 jacket per day with 4, 4.5 m pin piles per jacket) plus concurrent installation of OSP jacket (16, 4.5 m pin piles) and 4 WTG jacket (1 jacket per day with 4, 4.5 m pin piles per jacket) foundations for a total of 85 WTG jacket foundations and 1 OSP jacket foundation.
2. **Year 2 – WTG monopiles or WTG piled jackets, vibratory and impact piling with concurrent OSP installations.**
   a. Scenario 1 – Sequential installation of 65 WTG monopile foundations (9/16 m; assuming 1 pile per day for 35 of the monopiles and 2 piles per day for 30 of the monopiles) plus concurrent installation of OSP jacket (12, 4.5 m pin piles) and 3 WTG monopile (9/16 m; 1/day) foundations, all using only impact pile driving for a total of 68 WTG monopiles and 1 OSP jacket foundation.
   b. Scenario 2 – Sequential installation of 67 WTG monopile foundations (9/16 m; assuming 1 pile per day for 19 monopiles and 2 piles per day for 48 of the monopiles) using vibratory and impact piling plus concurrent installation of OSP jacket (12, 4.5 m pin piles) and 3 WTG monopile (9/16 m; 1/day) foundations using only impact pile driving, as well as 3 WTG monopile (9/16 m; assuming 1 pile per day) foundations using only impact pile driving, for a total of 73 WTG monopiles and 1 OSP jacket foundation.
   c. Scenario 3 – Sequential installation of 48 WTG jacket foundations (1 jacket per day with 4, 4.5 m pin piles per jacket) using vibratory and impact piling and 10 WTG jacket foundations using only impact pile driving (1 jacket per day with 4, 4.5 m pin piles per jacket) plus concurrent installation of OSP jacket (16, 4.5 m pin piles per jacket) and 4 WTG jacket (4, 4.5 m pin piles per jacket) foundations using only impact pile driving, for a total of 62 WTG jacket foundations and 1 OSP jacket foundation.

Each of the scenarios included an assumed distribution of installation days per month. Additional details regarding modeling and associated assumptions are available in SouthCoast Wind's Petition for Incidental Take Regulations (LGL 2024). Proposed monitoring and mitigation measures designed to minimize noise exposure to ESA-listed species in the Project area are presented in Section 3.3. Noise-related effects on each species group are discussed in the following sections.

Table 5.2-1. Assumptions used in WTG and OSP foundation installation scenarios by year for which acoustic and sound exposure modeling was conducted to estimate potential incidental take of marine mammals.

	YEAR 1			YEAR 2			
	WTG Monopiles (Scenario 1)	WTG Jackets (Scenario 2)	OSP Jackets	WTG Monopiles (Scenario 1)	WTG Monopiles (Scenario 2)	WTG Jackets (Scenario 3)	OSP Jackets
Foundations	71	85	1	68	73	62	1
Piles per foundation	1	4	12-16	1	1	4	12-16
Pile Diameter (m)	9/16	4.5	4.5	9/16	9/16	4.5	4.5
Target Penetration Depth (m)	35	60	60	35	35	60	60
Maximum Hammer Energy (kJ)[1]	6600	3500	3500	6600	6600	3500	3500
Impact or Vibratory	Impact	Impact	Impact	Impact	Both	Both	Impact
Impact piling strikes per pile[2]	7000	4000/NA	4000	7000	7000/5000	4000/2667	4000
Impact piling duty cycle[3]	30	30	30	30	30	30	30
Piling duration (hours) per foundation type	4	8	4	4	4	8	4
Piles Per Day	1 or 2	4	4	1 or 2	1 or 2	4	4
Total Pile Installation Days	59	85	3/4	53	49	62	3/4
Installation Years	1	1	1	1	1	1	1
Installation Months	May-Dec	May-Dec	Oct	May-Dec	May-Dec	May-Dec	Oct

m = meter; kJ = kilojoule
[1] The acoustic modeling assumed the maximum hammer energy was used for all strikes (Limpert et al. 2024, Tables 1–4)
[2]The first value shows the number of strikes if only impact pile driving is used while the second value shows the number of strikes if both vibratory and impact pile driving are used. For Year 1, even though a vibratory plus impact scenario was modeled this is not applicable (NA) because vibratory piling is no longer being considered in Year 1.
[3] Value shows the number of strikes per minute.
Note: Year 1 corresponds to Project 1 and Year 2 corresponds to Project 2.

5.2.2.1 Marine Mammals

Cetaceans (i.e., mysticetes and odontocetes) rely heavily on sound for essential biological functions, including communication, mating, foraging, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Anthropogenic underwater noise may have adverse impacts on marine mammals if the sound frequencies produced by the noise sources overlap with marine mammals' hearing ranges (NSF and USGS 2011). If such overlap occurs, underwater noise can result in behavioral and/or physiological effects, potentially interfering with essential biological functions (Southall et al. 2007).

The intense, impulsive noise (i.e., noise with rapid changes in sound pressure) associated with impact pile driving can cause behavioral and physiological effects in marine mammals. Potential behavioral effects of pile-driving noise include avoidance and displacement (Dähne et al. 2013; Lindeboom et al. 2011; Russell et al. 2016; Scheidat et al. 2011). Potential physiological effects include a TTS or PTS in an animal's hearing ability. Literature indicates that marine mammals would avoid disturbing levels of noise. However, individual responses to pile-driving noise are unpredictable and likely context specific. Behavioral effects and most physiological effects (e.g., stress responses and TTS) are expected to be short term and limited to the duration of pile driving within a 160 dB RMS isopleth distance from the pile being driven. Given that pile driving would occur in the open waters of the OCS, marine mammals would be able to avoid disturbing levels of noise. Any disruptions to foraging or other normal behaviors would be short term, and increased energy expenditures associated with this displacement are expected to be small. PTS could permanently limit an individual's ability to locate prey, detect predators, navigate, or find mates and could therefore have long-term effects on individual fitness.

To estimate radial distances to PTS thresholds (i.e., Level A harassment) for impact pile driving, NMFS (2018) hearing-group-specific, dual-metric thresholds for impulsive noise were used and marine mammal auditory cumulative SEL metric with frequency weighting were applied. To estimate radial distances to behavioral thresholds, NMFS' currently uses a step function to assess behavioral impact for intermittent sources, like impact pile driving, at SPL 160 dB re 1 µPa and for continuous sources, like vibratory pile driving, at SPL 120 dB re 1 µPa (NOAA 2005) (Table 5.2-2). All ESA-listed marine mammals evaluated in this BA belong to the low-frequency cetacean (LFC) group, except for sperm whales which belong to the mid-frequency cetacean (MFC) group. For the installation of WTGs and OSPs, scenarios for Years 1 and 2 include various combinations of sequential WTG foundation installations that use impact pile driving only, both vibratory and impact pile driving, and concurrent WTG and OSP installations using only impact pile driving, each of which generates different sound exposure levels. Year 1 involves impact-only pile driving installation while Year 2 involves both vibratory and impact pile driving installation. In scenarios where both vibratory and impact pile driving are considered in the installation of monopile or jacket foundations, sound from vibratory driving precedes sound from impact driving. Although the potential to induce hearing loss is low during vibratory driving, it does introduce sound into the water and must be considered in the total. For this reason, the combined sound energy from vibratory and impact pile driving was calculated. Installation of WTGs was modeled between May and December for Year 1 and Year 2, with concurrent installation of four pin-piles per day for OSP jackets modeled in October for both years. The modeling also used a 10-dB-per-hammer-strike noise attenuation to incorporate the use of noise-abatement systems[6] (e.g., bubble curtain system and an additional system). A broadband attenuation of 10 decibels equates to a sound energy level reduction of 90 percent (Limpert et al. 2024). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020).

[6] The noise-abatement system implemented must be chosen, tailored, and optimized for site-specific conditions.

Table 5.2-2. Marine mammal acoustic thresholds (dB) for impulsive and non-impulsive noise sources

Faunal Group	Injury - PTS			Impairment - TTS			Behavioral Disturbance	
	Impulsive L_{pk}	Impulsive L_E	Non-impulsive L_E	Impulsive L_{pk}	Impulsive L_E	Non-impulsive L_E	Intermittent L_p	Continuous L_p
LFC	219	183	199	213	168	179	160	120
MFC	230	185	198	224	170	178	160	120
HFC	202	155	173	196	140	153	160	120
PPW	218	185	201	212	170	181	160	120

dB = decibels; LFC = low-frequency cetaceans; MFC = mid-frequency cetaceans; HFC = high-frequency cetaceans; PPW = phocid pinnipeds (in-water); PTS = permanent threshold shift; TTS= temporary threshold shift
L_{pk} = peak sound pressure level in decibels (dB) referenced to 1 microPascal squared; also written SPL_{pk}
L_E = weighted cumulative sound exposure level in dB referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in dB referenced to 1 microPascal squared; also written SPL_{RMS} or L_{rms}
Sources: GARFO 2020; NMFS 2018.

The ranges to threshold levels resulting from the acoustic modeling are reported using two different terminologies to reflect the underlying assumptions of the modeling. The term “acoustic range” (R95%) refers to acoustic modeling results that are based only on sound propagation and sound source modeling and not on animal movement modeling. Acoustic ranges assume receivers of the sound energy (i.e., marine mammals) are stationary throughout the duration of the exposure. These are most applicable to thresholds where any single instantaneous exposure above the threshold is considered to cause a take, such as the Level A SPL_{pk} thresholds and the Level B SPL_{rms} thresholds. For SEL_{cum} based thresholds, acoustic ranges represent the maximum distance at which a receiver would be exposed above the threshold level if it remained present within that range during the entire sound-producing event or 24 hours, whichever is less. Since receivers are likely to move in and out of the threshold distance over the course of an exposure, animal movement modeling was used to estimate an “exposure range” (ER95%). This involves analyzing the species-specific movements of simulated animals (animats) and the horizontal distance that includes 95 percent of the closest point of approach (CPA) of animats exceeding a given impact threshold is determined. This provides a more realistic assessment of the distances within which animals would need to occur in order to accumulate enough sound energy to cross the applicable SEL_{cum} threshold. Exposure ranges to injury (Level A SEL_{cum}) and behavioral (Level B SPL_{rms}) thresholds to noise from pile driving were calculated and are presented in Table 5.2-3 and Table 5.2-4, respectively. Sound exposure was modeled as described in Section 5.2.2 for Years 1 and 2 assuming 10 decibels of attenuation in the summer and winter.

Effects of Noise Above the PTS Thresholds

For pile driving, the exposure ranges to Level A PTS thresholds varied by species for LFCs, sometimes up to 1,640 feet (500 meters), so each LFC species was evaluated separately. Depending on their proximity to the pile, individuals remaining within these distances for an extended period could experience Level A PTS without additional mitigation beyond the 10-decibel noise attenuation assumption included in the modeling (LGL 2024). For these results, all exposure ranges were larger in the winter than in the summer. Under the sequential, impact-only pile driving scenario, exposure ranges were larger when pile driving two WTG monopiles per day (ranging from 1.83 miles [2.95 kilometers] to 2.57 miles [4.15 kilometers]) versus one monopile per day (ranging from 1.75 miles [2.82 kilometers] to 2.48 miles [3.99 kilometers]). However, exposure ranges did not marginally differ between the sequential, impact-only installation of one or two WTG monopiles and those involving concurrent, impact-only installation of one WTG monopile and four OSP jacket pin piles. (Table 5.2-3). In comparison, exposure ranges were generally smaller during concurrent or sequential impact pile driving of four WTG and OSP jacket pin piles suggesting that the installation of jacketed foundations may lessen the extent of noise exposure leading to PTS.

Similarly, under the combined impact and vibratory installation methods for all three LFCs (fin, NARW, and sei), the smallest exposure ranges occurred during the installation of four WTG jacket pin piles. The highest exposure range for each species was roughly double the size of the lowest exposure range for each species or hearing group. No Level A exposures were calculated for blue whales due to very low densities, and sperm whales didn’t accumulate enough exposure to reach the MFC threshold at any distance.

Table 5.2-3. Exposure ranges[1] (ER 95%) to injury (Level A SELcum 2) thresholds for marine mammals during different WTG and OSP pile driving installation scenarios, assuming 10 dB of noise attenuation

Species/Faunal Group	YEAR 2		YEARS 1 and 2		YEARS 1 and 2			
	Combined [3] (impact + vibratory)		Concurrent (impact only)		Sequential (impact only)			
	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day	16 m WTG Monopile and 4.5 m OSP JPP 4 piles/day	4.5 m WTG JPP and 4.5 m OSP JPP 4 piles/day	16 m WTG Monopile 1 pile/day	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day	4.5 m OSP JPP 4 piles/day
Exposure Ranges (km) during Winter								
Fin whale	—	—	—	—	4.49	—	2.55	—
NARW	—	—	—	—	3.23	—	1.85	—
Sei whale (migrating)	—	—	—	—	3.38	—	2.22	—
MFC (e.g., sperm whale)	—	—	—	—	0	—	0	—
Exposure Ranges (km) during Summer								
Fin whale	4.11	2.25	4.25	3.58	3.99	4.15	2.37	3.18
NARW	3.07	1.57	2.85	1.92	2.82	2.95	1.73	2.01
Sei whale (migrating)	3.13	1.84	3.06	2.41	3.06	3.19	1.96	2.59
MFC (e.g., sperm whale)	0	0	0	0	0	0	0	0

dB = decibel; JPP = jacket pin piles; km = kilometer; m = meter; MFC = mid-frequency cetacean; NARW = North Atlantic right whale; OSP = offshore substation platform; WTG = wind turbine generator
dash (—) = no results because potential combined, concurrent or sequential installation would only occur in the summer months
[1] Exposure ranges are a result of animal movement modeling
[2] SEL_{cum} = weighted cumulative sound exposure level in dB referenced to 1 microPascal squared second; also written L_E
[3] Combined vibratory and impact pile driving would only occur in the summer months of Year 2
Source: Summarized from Tables 24 – 27 in MMPA Application (LGL 2024)

Acoustic Masking and Other Effects of Noise Above Behavioral Thresholds

Pile-driving activities have been shown to cause avoidance behaviors in most marine mammal species, although studies that specifically examine the behavioral responses of baleen whales to pile driving are absent from the literature. Behavioral avoidance of other impulsive noise sources has been documented and can be used as a proxy for impact pile driving. Malme et al. (1986) observed the responses of migrating gray whales to seismic exploration. At received levels of about 173 dB re 1 μPa, feeding gray whales had a 50 percent probability of stopping feeding and leaving the area. Some whales ceased to feed but remained in the area at received levels of 163 dB re 1 μPa. Individual responses were highly variable. Most whales resumed foraging activities once the air gun activities stopped. Dunlop et al. (2017) observed that migrating humpback whales would avoid air gun arrays up to 1.86 miles (3 kilometers) away when received levels were over 140 dB re 1 μPa (Dunlop et al. 2017). Cetaceans showed varying levels of sensitivity to continuous noise sources (i.e., active sonar), with observed responses ranging from displacement (Maybaum 1993) to avoidance behavior (i.e., animals moving rapidly away from the source) (Watkins et al. 1993), decreased vocal activity, and disruption in foraging patterns (Goldbogen et al. 2013).

Acoustic masking can occur if the frequencies of the activity overlap with the communication frequencies used by marine mammals. Modeling results indicate that dominant frequencies of impact pile-driving activities for the Proposed Action were concentrated below 1 kilohertz (LGL 2024). The short-term consequences of masking from Project activities range from temporary changes in vocalizations to avoidance. It is not known how often these types of vocal responses occur upon exposure to impulsive sounds, or what the long-term effects would be (LGL 2024). If marine mammals exposed to sounds sometimes respond by changing their vocal behavior, then this adaptation, along with directional hearing and preadaptation to tolerate some masking by natural sounds (Richardson et al. 1995), would all reduce the importance of masking. In this Project, impact pile driving is not expected to occur for more than approximately 4 hours at one time for monopile foundation installation and 2 hours per foundation for piled jacket installation. As a result, a complete masking of LFC marine mammal communications would not be expected during a given day. In addition, the duty cycle of sound sources is important when considering masking effects. Low-duty cycle sound sources such as impact pile driving are less likely to mask LFC communications, as the sound transmits less frequently with pauses or breaks between impacts, providing opportunities for communications to be heard.

The acoustic ranges (i.e., where 95 percent of the individuals would be exposed to a threshold from one pile driving event) were calculated to the unweighted 160 dB re 1 μPa Level B behavioral thresholds sound pressure level (SPL_{rms}) from impact pile driving and 120 dB re 1 μPa from vibratory pile driving, assuming 10 dB of noise attenuation (Table 5.2-4). Vibratory pile driving generates continuous underwater noise with lower source levels than impact pile driving. Vibratory hammering is accomplished by applying rapidly alternating (~25 hertz) forces to the pile that create non-impulsive, but continuous sound. Noise impacts from continuous noise sources are generally less severe compared to impacts from impulsive noise sources, but physiological effects may still occur in proximity to the noise source if source levels are sufficiently high and/or if animals remain in the vicinity and are exposed to those levels for a sufficient duration. Although the overall sound levels associated with vibratory hammering are typically lower than impact hammering, the lower behavioral disturbance threshold (120 dB re 1 μPa SPL_{rms}) for continuous sounds means that vibratory pile driving activity will often result in a larger area ensonified above that threshold and therefore a larger number of potential Level B exposures. Distances to injury thresholds for marine mammals, however, are shorter for non-impulsive sounds when compared to impulsive sounds (Matthews et al. 2018). Thus, it is unlikely that marine mammals would be exposed to vibratory pile driving at a sufficiently high level for a sufficiently long period to cause more than mild TTS.

For vibratory pile driving, which would only occur in Year 2, the largest unweighted acoustic range was 52.59 miles (84.63 kilometers) during the modeled installation of WTG monopiles (at two piles per day) in the winter, while the smallest unweighted acoustic range was 9.84 miles (15.83 kilometers) during the installation of WTG jacket pin piles in the summer (Table 5.2-4). Distances to Level B harassment thresholds were also calculated for impact-only pile driving installation scenarios. Individuals remaining within these distances from pile driving could experience behavioral effects without additional mitigation beyond the assumed 10-decibel noise attenuation included in the modeling (LGL 2024). For these results, acoustic ranges were larger in the winter than in the summer and was largest during the modeled installation of WTG monopiles (at two piles per day). Under this installation scenario, individuals within 5.36 miles (8.63 kilometers) of active impact pile driving could experience behavioral effects. The smallest acoustic ranges occurred during the modeled installation of WTG jacket pin piles as individuals would have to be within 2.60 miles (4.18 kilometers) of active impact pile driving to experience behavioral effects (Table 5.2-4).

Table 5.2-4. Acoustic ranges (R95%) to the Level B, 160 dB re 1 µPa sound pressure level (SPL^{rms}) threshold from impact pile driving and Level B, 120 dB re 1 µPa SPL_{rms} from vibratory pile driving under Year 2 scenarios, assuming 10 dB of noise attenuation

Faunal Group	YEARS 1 and 2			YEAR 2	
	Impact (160 dB SPL_{rms})			Vibratory (120 dB SPL_{rms})	
	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day	4.5 m OSP JPP 4 piles/day	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day
Acoustic Ranges (km) to Behavioral Thresholds during Winter					
Unweighted	8.63	4.41	5.24	84.63	21.92
Acoustic Ranges (km) to Behavioral Thresholds during Summer					
Unweighted	7.44	4.18	4.88	42.02	15.83

dB = decibel; JPP = jacket pin piles; km = kilometer; LFC = low-frequency cetaceans; MFC = mid-frequency cetaceans; OSP = offshore substation platform; WTG = wind turbine generator
SPL_{RMS} = root mean squared sound pressure level in dB referenced to 1 microPascal squared; also written L_p or L_{rms}
Source: Summarized from Table 23 in MMPA Application (LGL 2024)

The numbers of individual marine mammals predicted to receive sound levels above thresholds were determined using animal movement modeling in the same modeling exercise (LGL 2024). Based on the modeled results (Table 5.2-5), the greatest Level A exposure would occur during the installation of 73 WTG monopiles and 12 OSP jacket pin piles (under Scenario 2 of Year 2) as 15 fin whales, 3 NARW, and 2 sei whales may be exposed to cumulative sound exposure levels over a period of 24 hours (with 10 decibels of noise attenuation). Exposures were marginally lower during the modeled installation of 62 WTG jackets and 16 OSP jacket pin piles (under Scenario 3 of Year 2) as estimates for individuals exposed to Level A injury thresholds were reported to be 9 fin whales, 4 NARW, and 2 sei whales.

Similarly, the greatest Level B exposure would occur during the installation of 73 WTG monopiles and 12 OSP jacket pin piles with 1 blue whale, 481 fin whales, 100 NARWs, 42 sei whales, and 122 sperm whales that could be exposed to an individual sound pressure level (SPL_{rms}) exceeding the Level B threshold for behavioral impacts. Exposure estimates were smaller under Scenario 2 for Year 1 for most species: 1 blue whale, 23 fin whales, 12 NARWs, 7 sei whales, and 10 sperm whales, which suggests that the installation of WTGs and OSPs with jacket pin piling may lessen the extent of behavioral impacts compared to those caused by the installation of monopile WTGs. It is important to note that other than the assumed application of a 10-decibel noise attenuation from one or more NAS, the exposure estimates were calculated in the absence of the proposed monitoring and mitigation measures, which are designed to prevent most Level A and B exposures.

Table 5.2-5. Estimated Level A and Level B exposures under different installation scenarios for Years 1 and 2, assuming 10 dB of noise attenuation. Level B exposure modeling take estimates are based on distances to the unweighted 160 dB or 120 dB thresholds.

Species	Exposure Estimates (# individuals)									
	YEAR 1				YEAR 2					
	1Scenario 1: 71 WTG monopiles and 12 OSP JPP		1Scenario 2: 85 WTG jackets and 16 OSP JPP		1Scenario 1: 68 WTG monopiles and 12 OSP JPP		2Scenario 2: 73 monopiles and 12 OSP JPP		2Scenario 3: 62 WTG jackets and 16 OSP JPP	
	Total Level A (SEL_{cum})	Total Level B (SPL_{rms})	Total Level A (SEL_{cum})	Total Level B (SPL_{rms})	Total Level A (SEL_{cum})	Total Level B (SPL_{rms})	Total Level A (SEL_{cum})	Total Level B (SPL_{rms})	Total Level A (SEL_{cum})	Total Level B (SPL_{rms})
Blue whale	0	1	0	1	0	1	0	1	0	1
Fin whale	14	39	11	23	11	32	15	481	9	113
NARW	3	9	4	12	3	10	3	100	4	40
Sei whale	2	5	3	7	2	6	2	42	2	19
Sperm whale	0	13	0	10	0	11	0	122	0	36

SEL_{cum} = weighted cumulative sound exposure level in decibels (dB) referenced to 1 microPascal squared second; also written L_E
SPL_{rms} = root mean squared sound pressure level in dB referenced to 1 microPascal squared; also written L_p or L_{rms}
dB = decibels; JPP = jacket pin piles; NARW = North Atlantic right whale; OSP = offshore substation platform; WTG = wind turbine generator
[1] Impact only pile driving
[2] Combined vibratory and impact pile driving
Source: Summarized from Tables 25 to 29 in MMPA Application (LGL 2024)

Considering the results of the underwater noise modeling and the large radial distances to PTS and behavioral thresholds, individual fitness-level impacts could occur due to pile driving activities. To help mitigate these impacts, a range of mitigation and monitoring measures will be implemented to avoid and/or reduce the effects of pile driving noise on marine mammals (Section 3.3, Table 3.3-1 and Table 3.3-2). These include the utilization of protected species observers and PAM systems to monitor and enforce appropriate monitoring and exclusion zones (BA-11, BA-15, BA-22, BA-23, BA-25, BA-26), soft-start procedures to deter marine mammals from pile driving activities, shutdown zones (BA-20, BA-27), noise-reduction technologies (BA-24), and reporting protocols (BA-12, BA-28).

Noise abatement systems (NAS), can be particularly effective in reducing the overall acoustic energy that is introduced in the environment and have shown that broadband sound levels can likely be reduced by 7 to 17 dB, depending on the environment, pile size, and configuration of the systems used (Buehler et al. 2015, Bellman et al. 2020). While the type and number of NAS to be used during construction have not yet been determined, it can be expected that a combination of systems (e.g., double big bubble curtain, hydrosound damper plus single bubble curtain) are reasonably expected to achieve more than a 10-decibel broadband attenuation from impact pile driving sounds, so exposures will likely be lower than the modeled results. SouthCoast Wind will operate NAS to meet noise levels modeled (10 dB attenuation) and will not exceed these levels. However, if SSV suggests noise levels are louder than modeled, additional noise attenuation measures will be implemented to further reduce noise levels to at least those modeled.

Shutdown procedures will also be implemented should a marine mammal be detected entering within the respective shutdown zone. Shutdown zones, as presented in the MMPA ITA and summarized in Table 3.3-1, are based on the Level A exposure ranges with 10-decibel noise attenuation for foundation installation across Year 1 and Year 2. If the shutdown zone is equivalent to the “NAS perimeter”, this means the outside perimeter of the NAS. Therefore, any animals occurring within the NAS would trigger a shutdown. The NARW shutdown zones are based on the requirement that a visual or acoustic observation of a NARW at any distance will result in immediate shutdown measures. The shutdown zones, ranging from 656 to 12,139 feet (200 to 3,700 meters), are the largest zone sizes expected to result from foundation installations for each installation schedule. If smaller diameter piles, lower maximum hammer energies and/or total strikes per pile, or a more effective NAS are decided upon and used during the construction activities, modeled Level A exposure ranges applicable to those revised parameters would be used along with smaller shutdown zone distances than those based on current maximum pile size and energy assumptions.

The proposed requirement that impact pile driving can only commence when the pre-clearance zones are fully visible to PSOs allows for a high marine mammal detection capability and enables a high rate of success in implementing these zones to avoid serious injury to marine mammals. A pre-start clearance period will be implemented for all foundation installations inside and outside the NMFS 20-kilometer area of concern. Foundations installed within the 20-kilometer area of concern (June 1 through October 15) will have a minimum visibility zone[7] of 3 miles (4,900 meters) for pin pile and 4.7 miles (7,500 meters) for monopile installation implemented. OSP foundations (and WTG jacket foundations, if installed) installed throughout the rest of the Lease Area (outside the area of concern), will have a minimum visibility zone[8] of 1.62 miles (2,600 meters) for pin pile and 2.3 miles (3,700 meters) for monopile and pin pile installation implemented. Acoustic Protected Species Observer (APSO) will be conducting acoustic monitoring in coordination with the visual PSOs, during all pre-start clearance, piling, and post-piling monitoring periods (daylight, reduced visibility, and nighttime monitoring).

SouthCoast Wind has proposed nighttime pile driving (Section 3.1.2.3.2) to complete installation within as few years as possible during the multi-year installation campaign. As outlined in the MMPA ITA, piling during the night would reduce the total duration of construction activities, limit crew transfers and vessel trips, and concentrate construction during the time of the year when NARW are less likely to be present (May 15 through December 31), thereby, reducing the overall potential impact on this species. During these periods of low visibility, nighttime monitoring will employ the best currently available technology that can reliably monitor clearance and shutdown zones to mitigate potential impacts. Monitoring methods will include the use of night vision equipment (e.g., night vision goggles) and infrared/thermal imaging technology.

Recent studies have concluded that the use of infrared/thermal imaging technology allow for the detection of marine mammals at night (Verfuss et al. 2018). Guazzo et al. (2019) showed that the probability of detecting a large whale blow by a commercially available infrared camera was similar during night and day; camera monitoring distance was 1.3 miles (2.1 kilometers) from an elevated vantage point at night versus 1.9 miles (3 kilometers) for daylight visual monitoring from the same location. Advancements in

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

[8] The minimum visibility zone sizes implemented during foundation installation of pin piles and monopiles occurring throughout the rest of the Lease Area (outside the area of concern) are set equal to the second largest low-frequency Level A SEL_{cum} exposure ranges (ER95%) with 10 dB of noise attenuation for foundation installation across Year 1 and Year 2.

nighttime detection such as the use of electro-optical and infrared (EO/IA) thermal imaging coupled with visual and passive acoustic monitoring have been demonstrated to reliably monitor regulated zones in different environmental conditions, which lends a viable option in monitoring protected species during nighttime operations (ThayerMahan, 2023). An NPDP and AMP will be submitted to BOEM and NMFS for review prior to any low-visibility or nighttime pile driving activity (BA-15, Table 3.3-2). These plans will describe the methods, technologies, and mitigation requirements for any low-visibility or nighttime pile driving activities. The NPDP should sufficiently demonstrate the efficacy of the alternative technologies and methods in monitoring the full extent of clearance and shutdown zones in order to obtain approval for nighttime pile driving activities. In the absence of an approved NPDP, nighttime pile driving would only occur if unforeseen circumstances prevented the completion of pile driving during daylight hours and it was deemed necessary to continue piling during the night to protect asset integrity or safety.

Since visual observations within the applicable shutdown zones can become impaired at night or during daylight hours due to fog, rain, or high sea states, visual monitoring with thermal and night vision devices (NVDs) will be supplemented by a real-time PAM system during these periods. The use of PAM (or alternative) will supplement visual observations during pre-start clearance, piling, and post-piling monitoring periods. A combination of alternative monitoring measures, including PAM, has been demonstrated to have comparable detection rates (although limited to vocalizing individuals) to daytime visual detections for several species (Smith et al., 2020). A Pile-Driving Monitoring (PDM) Plan will be submitted to BOEM, BSEE, and NMFS for review, which will describe the visual and PAM components including all equipment, procedures, and protocols (BA-17). The PAM system will be designed to detect vocalizations from all marine mammals potentially present in the region, including low-frequency cetaceans such as NARW and fin whale, and should demonstrate detection capability in monitoring the full extent of the 120 decibel (for vibratory pile driving) or 160-decibel (for impact pile driving) distance from the pile driving location.

In response to concerns related to NARW habitat use of the Nantucket Shoals region, SouthCoast Wind has proposed additional mitigation and monitoring plans for pile driving (Supplemental North Atlantic Right Whale Monitoring and Mitigation Plan for Pile Driving [SouthCoast Wind 2024]). These specific measures, summarized in Table 3.3-1, include increased monitoring coverage for impact pile driving especially within 20-kilometer NMFS area of concern. This plan intends to increase the probability of NARW detection and describes the methods that will be used to monitor the pre-start clearance and shutdown zones as well as the Level B disturbance zones during installation of Project foundations that occur within the area of concern. The pre-start clearance and shutdown zone for NARW will be extended to include a visual detection of a NARW at any distance from the pile being installed. This includes increasing the number of PSOs on duty (three PSOs on each monitoring vessel) and the number of monitoring vessels (three in the Lease Area, four in the 20-kilometer area of concern) as well as in the rest of the Lease Area from May 15 to 31 and the entire month of December. Within the 20-kilometer area of concern, the minimum visibility zone (required to be completely visible to initiate pile driving) would be equivalent to the Level B harassment zone for monopiles (7,500 meters) and pin piles (4,900 meters). Visual monitoring would then be conducted to cover double the relevant Level B harassment zone for the installation of monopiles (15 kilometers) and pin piles (10 kilometers). Similarly, a distance larger than the Level B harassment zones will be acoustically monitored by deploying a PAM array to cover a 15-kilometer zone for monopile installation and a 10-kilometer zone for pin pile installation. Prior to the initiation of pile driving, NARW calls localized within the relevant PAM clearance zone will result in a delayed start or shutdown of pile driving. Once pile driving begins, the PAM shutdown zone, which is an acoustic observation of a NARW at any distance, will result in immediate shutdown measures. If a delay or shutdown of pile driving is triggered by an acoustic detection localized within the 15-km zone for monopiles or the 10-km zone for pin piles, pile installation may not resume until the following day and must be preceded by a vessel-based survey in each respective zone to ensure no NARWs are detected. A delay or shutdown of pile driving triggered by visual detection of fewer than three NARWs will postpone the installation for one day preceded by a vessel-based survey, while a visual detection of three or more NARWs will postpone the installation for two days. Additionally, no pile driving for WTG or OSP foundation installations will occur within the 20-kilometer area of concern during the month of May or after October 15.

As Nantucket Shoals is a known area of high primary productivity and a NARW winter foraging ground, implementing mitigation measures within this area are particularly crucial in minimizing the effects of Project activities to NARWs. Other measures that will be implemented to further reduce such effects include adherence to pile driving time-of-year restrictions (BA-14, Table 3.3-2) and to only use impact pile driving for foundation installations of Project 1 (Year 1) due to concerns of the larger ensonified area associated with vibratory piling. Agency-proposed time-of-year restrictions will also be implemented in the enhanced mitigation area near Nantucket Shoals (NS-4) wherein pile driving can only occur between June 1 to October 31 when NARW density is at its lowest (Section 3.3, Table 3.3-2).

While behavioral and masking effects are more difficult to mitigate and are, therefore, still considered likely for activities with large acoustic disturbance areas such as impact pile driving, the implementation of a 30-minute pre-start clearance period where the shutdown zones are monitored will limit the potential for behavioral disturbance to all ESA-listed marine mammal species. A sound source verification (SSV) plan will be developed to allow for adaptive monitoring and the adjustment of these clearance zones, as needed, based on reported measurements (Table 3.3-1 and Table 3.3-2, BA-19, BA-20, BA-25). If a marine mammal were exposed to underwater noise above behavioral thresholds, it could result in displacement from a localized area around a pile. However, this displacement would be temporary for the duration of activity, which would be a maximum of four hours per pile, for two piles per day, with a four-hour break before another pile would be driven during monopile installation. NARW (and any LFCs) could be expected to resume their previous behavior (e.g., pre-construction activities) following this 12-hour period. The energetic consequences of any avoidance behavior and potential delay in resting or foraging 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 calving. Any physiological effects resulting from changes in behavior would be expected to resolve within hours to days of exposure and are not expected to affect the health of any individual whale or its ability to migrate, forage, breed, or calve.

Overall, the potential for serious injury is minimized by the strict implementation of the mitigation measures as discussed above. Slight PTS (i.e., minor degradation of hearing capabilities at some hearing thresholds) may be expected but as the shutdown and clearance zones would cover the largest PTS zone of influence, the likelihood of exposure leading to PTS would be greatly reduced. Given a marine mammal's transient nature and ability to move away from noise disturbance, the potential for exposure to noise levels leading to behavioral disruption would also be reduced at the level of the individual animal and would not be expected to have population level effects.

As outlined in Table 5.2-5, no PTS (Level A) exposures are expected for blue whales and sperm whales, while exposures leading to PTS or auditory injury (Level A) are anticipated for fin whales, NARW, and sei whales in the absence of mitigation measures beyond the use of a 10 dB NAS. However, with the implementation of the described mitigation and monitoring efforts, the likelihood of auditory injury would be reduced to the point of being **discountable.** Exposures leading to behavioral disturbance (Level B) are anticipated for blue whales, fin whales, NARWs, sei whales, and sperm whales. However, monthly average densities for blue whales within 10 kilometers of the Lease Area were zero year-round; since they are extremely unlikely to occur in the Project area, noise effects for blue whale are **discountable**. Given the anticipated Level B exposures for the remaining species in Table 5.2-5, behavioral impacts from pile driving cannot be discounted. Therefore, noise exposure from Project pile driving leading to behavioral disturbance **may affect, likely to adversely affect** fin whales, NARWs, sei whales, and sperm whale.

5.2.2.2 Sea Turtles

Pile driving noise can cause behavioral or physiological effects in sea turtles. The effects of introduced sound on sea turtles during construction are only expected to occur when turtles are present during the summer and early fall. Potential behavioral effects of pile driving noise include altered dive patterns, short-term disturbance, startle responses, and short-term displacement (NSF and USGS 2011; Samuel et al. 2005). Potential physiological effects include temporary stress response and, close to the pile-driving activity, TTS or PTS. Due to the anticipated short, intermittent pile driving period, behavioral effects and most physiological effects are expected to be short-term and localized to the ensonified area, thus, any disruptions to foraging or other normal behaviors would be temporary and increased energy expenditures associated with displacement are expected to be small. However, PTS could permanently limit an individual's ability to locate prey, detect predators, or find mates and could therefore have long-term effects on individual fitness.

To estimate radial distances to injury and behavioral thresholds for impact pile driving, peak SPLs and frequency-weighted accumulated SELs for the onset of PTS in sea turtles from Finneran et al. (2017) and behavioral response thresholds from McCauley et al. (2000) were used (Table 5.2-6) based on the behavioral threshold recommended in the GARFO acoustic tool (GARFO 2020). As described in Section 5.2.2, modeling was performed under different foundation installation scenarios for each year of construction: Year 1 assumed WTG foundation installations will use impact pile driving only, and Year 2 assumed WTG foundation installations will use either a combination of vibratory and impact pile driving, or impact pile driving only. The modeling also includes concurrent installation of WTG and OSP foundations during which only impact pile driving was assumed. Under any foundation installation scenario, the modeling did not exceed SPL_{pk} thresholds for any sea turtles indicating that noise from a single pile driving event would not cause injury or impairment when mitigated with 10-decibel broadband noise attenuation.

Table 5.2-6. Sea turtle acoustic thresholds (dB) for impulsive and non-impulsive noise sources

Faunal Group	Injury – PTS			Impairment – TTS			Behavioral Disturbance
	Impulsive L_{pk}	Impulsive L_E	Non-impulsive L_E	Impulsive L_{pk}	Impulsive L_E	Non-impulsive L_E	L_p
Sea turtles	232	204	220	226	189	200	175

dB = decibels; PTS = permanent threshold shift; TTS= temporary threshold shift
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}
Sources : Summarized from Table 17 Appendix A, MMPA ITA (Limpert et al. 2024), Finneran et al. 2017, and McCauley et al. 2000

The cumulative exposure ranges to injury (SEL_{cum}) for all sea turtle species under all foundation installation scenarios and combinations of vibratory and impact pile driving had a maximum range of 0.62 miles (1 kilometer) (Table 5.2-7). Exposure ranges were nearly identical between combined (impact plus vibratory) and sequential (impact only) installation scenarios, apart from an increase in exposure range for green sea turtles exposed under sequential jacket pin pile installation from < 0.006 miles (< 0.01 kilometers) to 0.09 miles (0.15 kilometers). Exposure ranges were largest under the concurrent, impact-only installation of WTG monopiles and OSP jacket pin piles in the summer followed by the sequential, impact-only installation of WTG monopiles (at 1 pile per day) in the winter. Exposure ranges were smallest for any installation scenario of WTG jacket pin piles. As the modeling assumed higher density estimates for leatherback sea turtles, this species exhibited the largest exposure range compared to the other sea turtle species, from 0.23 – 0.62 miles (0.37 – 1.00 kilometer). The next largest exposure range was calculated for the green sea turtle, with an exposure to injury range of < 0.006 – 0.37 miles (0.01 – 0.60 kilometers). Kemp's ridley sea turtle had a small exposure range, from 0 – 0.24 miles (0 – 0.39 kilometers), and the loggerhead turtle had the smallest exposure range from 0 – 0.14 miles (0 – 0.22 kilometers). Depending on species, sea turtles that remain within < 0.006 – 0.62 miles (0.01 – 0.99 kilometers) of pile driving over 24 hours could experience PTS, assuming 10 decibels of noise attenuation (Table 5.2-7). It is important to note that in the modeling analysis, the more recent leatherback and loggerhead densities extracted from Kraus et al. (2016) for summer and fall 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 thus more conservative. It should also be noted that density estimates for Kemp's Ridley sea turtles were used as a surrogate for green sea turtles as Kraus et al (2016) did not observe green sea turtles in the RI/MA WEA during the survey period. Despite the same density values applied to both species, the animal movement modeling produced distinct acoustic exposure levels due to the unique behaviors of each sea turtle species that were taken into account in the modeling analysis.

Table 5.2-7. Exposure ranges to injury (SEL_{cum}1) thresholds for sea turtles under different WTG and OSP pile driving installation scenarios, assuming 10 dB of noise attenuation

Species	YEAR 2			YEARS 1 and 2		YEARS 1 and 2			
	Combined [2] (impact + vibratory)			Concurrent (impact only)		Sequential (impact only)			
	16 m WTG Monopile 1 pile/day	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day	16 m WTG Monopile and 4.5 m OSP JPP	4.5 m WTG JPP and 4.5 m OSP JPP	16 m WTG Monopile 1 pile/day	16 m WTG Monopile 2 piles/day	4.5 m WTG JPP 4 piles/day	4.5 m OSP JPP 4 piles/day
Exposure Ranges (km) during Winter									
Kemp's ridley turtle	—	—	—	—	—	0.31	—	0	0.13
Leatherback turtle	—	—	—	—	—	1	—	0.37	0.57
Loggerhead turtle	—	—	—	—	—	0.01	—	0	0
Green turtle	—	—	—	—	—	0.68	—	0.15	0.15
Exposure Ranges (km) during Summer									
Kemp's ridley turtle	0.2	0.39	0	0.35	0.03	0.18	0.39	0	0.13
Leatherback turtle	1	0.89	0.39	0.99	0.45	1	0.89	0.37	0.57
Loggerhead turtle	0.01	0.02	0	0.22	0	0.01	0.13	0	0
Green turtle	0.49	0.55	< 0.01	0.6	0.2	0.48	0.55	0.15	0.15

dB = decibel; km = kilometer; m = meter; JPP = jacket pin piles; WTG = wind turbine generators; OSP = offshore service platform
dash (—) = no results because potential combined, concurrent or sequential installation would only occur in the summer months
[1] SEL_{cum} = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written L_E
[2] Combined vibratory and impact pile driving would only occur in the summer months of Year 2
Source: Summarized from Tables 41 – 49 (Limpert et al. 2024) and H-50 – 64 in Appendix A of the MMPA Application (LGL 2024)
Density estimates are derived from the Strategic Environmental Research and Development Program – Spatial Decision Support System (Kot et al 2018).
Density estimates for leatherback sea turtles during the summer are averaged seasonal densities from 2011 to 2015 (Kraus et al. 2016).
Density estimates for loggerhead sea turtles during the summer were 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).
Densities of Kemp's ridley sea turtles are used for green sea turtles, as Kraus et al. 2016 did not observe any green sea turtles in the Lease Area.

In addition to exposure ranges calculated with animal movement, the potential effects of sound were also summarized as acoustic radial distances, which are the distances over which at least 95 % of the horizontal area that would be exposed to sound at or above the specified level occurred, assuming no animal movement (i.e., static receiver). As discussed in Section 5.2.2, sounds produced from the installation of WTG and OSP foundations were modeled at two representative locations in the Lease Area. Based on the modeled results at Location 1, pile driving sound levels could exceed cumulative injury thresholds for a "static receiver" sea turtle that remained within 1.37 – 1.43 miles (2.2 – 2.3 kilometers) of the sound over 24 hours with 10-decibel noise attenuation during monopile driving, and 0.81 miles (1.3 kilometers) during post-piled jacket pin pile driving, or 0.56 miles (0.9 kilometers) during pre-piled jacket pin pile driving (Table 5.2-8). At Location 2, the radial distances to cumulative injury thresholds were about 1.12 miles (1.8 kilometers) for monopile driving and 0.75 miles (1.2 kilometers) for post-piled jacket pin-pile driving, or 0.56 miles (0.9 kilometers) for pre-piled jacket pin pile driving. Sound levels could exceed behavioral thresholds for a "static receiver" sea turtle during monopile driving with 10 dB of noise attenuation within 1.18 – 1.24 miles (1.9 – 2.0 kilometers) at Location 1 and 0.99 – 1.06 miles (1.6 – 1.7 kilometers) at Location 2. Sound levels could exceed behavioral thresholds within about 0.43 miles (0.7 kilometers) during post-piled jacket pin-piling with 10-decibel noise attenuation at both locations. Behavioral thresholds could be exceeded at 0.31 miles (0.5 kilometers) during pre-piled jacket pin pile driving. Additionally, acoustic distances were slightly higher in the winter than in the summer at both locations.

Table 5.2-8. Summary of acoustic radial distances (R95% in kilometers) for sea turtles during monopile impact pile installation at the higher impact of two modeled locations for both seasons, with 10 dB noise attenuation from a noise abatement system

Scenario	Location 1			Location 2		
	Injury [a] L_{pk}	Injury [a] L_E	Behavior [b] L_p	Injury [a] L_{pk}	Injury [a] L_E	Behavior [b] L_p
Range (km) during Winter						
16 m Monopile Scenario, NNN 6600 (b) hammer	–	2.27	2.00	–	1.82	1.68
4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer	–	1.30	0.73	–	1.22	0.73
4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	–	0.93	0.48	–	0.93	0.52
Range (km) during Summer						
16 m Monopile Scenario, NNN 6600 (b) hammer	–	2.19	1.92	–	1.75	1.61
4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer	–	1.30	0.72	–	1.18	0.72
4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	–	0.92	0.48	–	0.91	0.53

dB = decibels; km = kilometer; m = meter;
L_{pk} = peak sound pressure level in decibels (dB) referenced to 1 microPascal squared; also written SPL_{pk}

L_E = weighted cumulative sound exposure level in dB referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in dB referenced to 1 microPascal squared; also written SPL_{RMS} or L_{rms}
( ) dash indicates that distances could not be calculated because thresholds were not reached.
[a] Finneran et al. (2017)
[b] McCauley et al. (2000)
Source: Summarized from Tables 50 – 55 in Limpert et al. (2024)

The same exposure modeling was also used to estimate the number of individuals of each ESA-listed species that could be exposed to injury and behavioral effects from pile driving. The results show that assuming 10 decibels of noise attenuation, the greatest Level A exposure in Year 1 would occur during the installation of 71 WTG monopiles and 12 OSP jacket pin piles (under Scenario 1) with a maximum of 2.15 leatherback sea turtles and < 0.5 each of loggerhead, Kemp's ridley, and green sea turtles that may be exposed to cumulative sound levels exceeding recommended injury thresholds (SEL_{cum} or L_E) (Table 5.2-9). Similarly, in Year 2, the greatest Level A exposure would occur during the installation of 73 WTG monopiles and 12 OSP jacket pin piles (Scenario 2) with a maximum of 2.31 leatherback sea turtles and < 0.5 each of loggerhead, Kemp's ridley, and green sea turtles that may be exposed to cumulative sound levels exceeding injury thresholds. No sea turtles were reported to be exposed during a single pile driving (SPL_{pk} or L_{pk}) event under any installation scenarios in both years.

For behavioral effects, the greatest Level B exposure would occur during the installation of 73 WTG monopiles and 12 OSP jacket pin piles (under Scenario 2 of Year 2) with a maximum of 6.25 leatherback sea turtles, 4.29 loggerhead sea turtles, and < 0.5 each of Kemp's ridley and green sea turtles that may be exposed to sound exceeding behavioral thresholds (SPL_{rms} or L_p). Exposures were similar during the installation of 71 WTG monopiles and 12 OSP jacket pin piles (under Scenario 1 of Year1).

Generally, exposures were much lower under any scenarios involving the installation of WTG and OSP jacket pin piles, suggesting that foundation installations using jacket pin piling may lessen the extent of behavioral and injurious levels of disturbance than monopile driving. In addition, these exposure estimates do not consider potential behavioral avoidance or the use of PSOs, shutdown procedures, and other mitigation measures beyond the 10 dB noise attenuation applied during modeling, and are thus, considered conservative estimates of exposure.

Table 5.2-9. Estimated individuals exposed to injury and behavior threshold levels of sound under different installation scenarios for Years 1 and 2, assuming 10 dB of noise attenuation.

Species	Exposure Estimates (# individuals)														
	Year 1						Year 2								
	[1]Scenario 1: 71 WTG monopiles and 12 OSP JPP			[1]Scenario 2: 85 WTG jackets and 16 OSP JPP			[1]Scenario 1: 68 WTG monopiles and 12 OSP JPP			[2]Scenario 2: 73 monopiles and 12 OSP JPP			[2]Scenario 3: 62 WTG jackets and 16 OSP JPP		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	L_{pk}	L_E	L_p	L_{pk}	L_E	L_p	L_{pk}	L_E	L_p	L_{pk}	L_E	L_p	L_{pk}	L_E	L_p
Kemp's ridley turtle	0	< 0.01	0.11	0	< 0.01	< 0.01	0	< 0.01	0.11	0	< 0.01	0.12	0	< 0.01	< 0.01
Leatherback turtle	0	2.15	5.61	0	0.59	1.77	0	1.97	5.71	0	2.31	6.25	0	0.4	1.25
Loggerhead turtle	0	0.16	3.94	0	0	3.45	0	0.12	4.03	0	0.19	4.29	0	0	2.6
Green turtle	0	< 0.01	0.1	0	< 0.01	< 0.01	0	< 0.01	0.1	0	< 0.01	0.11	0	< 0.01	< 0.01

dB = decibels; JPP = jacket pin piles; OSP = offshore substation platform; WTG = wind turbine generator
L_{pk} = peak sound pressure level in decibels (dB) referenced to 1 microPascal squared; also written SPL_{pk}
L_E = weighted cumulative sound exposure level in dB referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in dB referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}
[1] Impact only pile driving
[2] Combined vibratory and impact pile driving
Source: Summarized from Table 29 to Table 31 (Limpert et al. 2024) and Tables H-23 to 28 in Appendix H of the MMPA Application (LGL 2024).
Density estimates are derived from the Strategic Environmental Research and Development Program – Spatial Decision Support System (Kot et al 2018).
Density estimates for leatherback sea turtles during the summer are averaged seasonal densities from 2011 to 2015 (Kraus et al. 2016).
Density estimates for loggerhead sea turtles during the summer were 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).
Densities of Kemp's ridley sea turtles are used for green sea turtles, as Kraus et al. 2016 did not observe any green sea turtles in the Lease Area.

The potential for injury and behavioral disturbance is minimized by implementing a range of required mitigation measures (Section 3.3, Table 3.3-2). These measures include reporting protocols (BA-12, BA-28) and the implementation of mitigative actions such as pre-clearance (BA-23), shutdown zones (BA-20, BA-27, BA-32), and ramp-ups (BA-18) that would facilitate a delay of pile driving if sea turtles were observed approaching. Active visual monitoring (BA-15 to BA-17, BA-19 to BA-21) of the zone of influence (820.2 feet [250 meters]) is considered highly effective in mitigating cumulative PTS effects for sea turtles. Visual monitoring will be conducted 60 minutes before pile-driving activities, during pile driving and 30 minutes post-completion of pile-driving activity (BA-21).

As stated in Section 3.1.2.3.2, pile driving may occur during nighttime hours. During nighttime or periods of low visibility, visual monitoring will use the best currently available technology (e.g., thermal camera systems, IR spotlights, and NVDs) that can reliably monitor clearance and shutdown zones to mitigate potential impacts (BA-15, Table 3.3-2). Prior to any low-visibility or nighttime pile driving activity, an AMP and NPDP will be submitted to BOEM and NMFS for review (BA-15, Table 3.3-2). The AMP and NPDP will describe the methods, technologies, and mitigation requirements for any low-visibility or nighttime pile driving activities. The NPDP should sufficiently demonstrate the efficacy of the alternative technologies and methods in monitoring the full extent of clearance and shutdown zones in order for nighttime pile driving to be approved. In the absence of an approved NPDP, nighttime pile driving would only occur if unforeseen circumstances prevented the completion of pile driving during daylight hours and it was deemed necessary to continue piling during the night to protect asset integrity or safety.

The implementation of noise-reduction technologies such as bubble curtains or a combination of systems (e.g., double big bubble curtain, hydrosound damper plus big bubble curtain) can also greatly reduce impact pile driving sounds (BA-24, Table 3.3-2). In addition, ramp-ups could be effective in deterring turtles from impact pile driving activities prior to exposure resulting in injury. The proposed requirement that impact pile driving can only commence when the pre-clearance zones are fully visible to PSOs (BA-22, Table 3.3-2) allows a high sea turtle detection capability and enables a high rate of success in implementation of these zones to avoid disturbance. These mitigation measures lower the likelihood for any ESA-listed turtle to be exposed to impact pile driving noise that would result in severe hearing impairment or serious injury.

Both injury and behavior exposures are expected to be negligible (< 0.5 individuals) for Kemp's ridley and green sea turtles due to their rarity in the area. The potential for PTS and behavioral disturbance for these two species is considered extremely unlikely to occur and is **discountable**. Impacts at the population level are not anticipated, given the low density of turtles in the Project area and the localized nature of noise impacts. Therefore, exposures leading to PTS or behavioral disturbance **may affect, not likely to adversely affect** Kemp's ridley and green sea turtles.

Given the relatively small size of turtles and the significant time spent at or just below the surface, sea turtles may be difficult to monitor, especially during low light conditions or at night. While the measures described above may reduce the potential for PTS or behavioral disturbance in sea turtles, it would not completely eliminate such risks. However, as reported in the modeling results (Table 5.2-9), with 10 decibels of noise attenuation, a maximum of seven leatherback sea turtles and five loggerhead sea turtles may be exposed to noise above behavioral thresholds. A maximum of three leatherback and one loggerhead sea turtles may also be exposed to cumulative pile driving noise above PTS thresholds. Given the low number of potential exposures from pile driving, the likelihood of population-level impact is low. It is likely that the pre-clearance zone (1,640 feet [500 meters]) would cover the Level B behavioral harassment zone; however, as the maximum acoustic radial distances leading to behavioral disturbance (e.g., ≥ 1.24 miles [2 kilometers]) exceeds the pre-clearance zone, increasing the clearance and shutdown zones and the adaptive refinement of pile-driving monitoring protocols through the Sound File Verification Plan (SFVP) will be necessary to sufficiently mitigate any potential Level A and Level B harassment (BA-19 and BA-20, Table 3.3-2).

While the mitigation and monitoring measures and the animal's ability to avoid areas of loud construction noise are expected to decrease the potential impacts of these ESA-listed species to underwater noise, anticipated exposures above PTS and behavioral thresholds cannot be discounted for loggerhead and leatherback sea turtles that are more common in the area. Therefore, the effects of noise exposure from Project pile driving leading to PTS and behavioral disturbance **may affect, likely to adversely affect** leatherback and loggerhead sea turtles.

5.2.2.3 Fish

Impact pile driving noise can cause behavioral changes, physiological effects (including TTS), or mortality in fish. Behavioral effects vary among individuals and include, but are not limited to, startle responses, cessation of activity, and avoidance. Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause TTS, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015). Fish are not known to develop PTS, potentially due to an ability to repair and regenerate hair cells in the inner ear damaged from sound exposure (Smith et al. 2006; Popper et al. 2007). Developmental abnormalities in early life stages of fishes resulting from pile-driving noise have been documented (Weilgart 2018; Hawkins and Popper 2017). Pile-driving noise could also result in reduced reproductive success while pile-driving is occurring, particularly in species that spawn in aggregate. Pile-driving noise may injure or kill early life stages of finfish and invertebrates at short distances (Weilgart 2018; Hawkins and Popper 2017).

To estimate acoustic radial distances to injury thresholds for impact pile driving, fish injury thresholds for different sized fish from the Fisheries Hydroacoustic Working Group (2008) and Stadler and Woodbury (2009) and for fish with different hearing capabilities (i.e., without swim bladder, with swim bladder not involved in hearing, and with swim bladder involved in hearing) from Popper et al. (2014) were used (Table 5.2-10). Fish with a swim bladder involved in hearing (e.g., herrings, gadids) are most susceptible to pile-driving noise while those without swim bladders (e.g., flatfish, rays, sharks) are least susceptible (Popper et al. 2014). While ESA-listed fish evaluated in this BA (i.e., subadult and adult Atlantic sturgeon) is categorized as both "fish larger than 2 grams" and "fish having a swim bladder not involved in hearing", as a conservative measure, acoustic thresholds for the Atlantic sturgeon in this BA were based on "fish larger than 2 grams".

Table 5.2-10. Fish acoustic thresholds for impulsive noise sources

Fish Group	Onset of Physical Injury		Behavioral Disturbance
	L_{pk}	L_E	L_p
Fish ≥ 2 grams[a]	206	187	150
Fish < 2 grams[a,b]	206	183	150
Fish without swim bladder[c]	213	216	150
Fish with swim bladder not involved in hearing[c]	207	203	150
Fish with swim bladder involved in hearing[c]	207	203	150

Note: NMFS does not have physical injury thresholds for non-impulsive sources, except tactical sonar
dB = decibels
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}
Sources:
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group 2008;

[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007)
[c] Popper et al. 2014

To estimate radial distances to behavioral thresholds for fish, thresholds developed by the NMFS Greater Atlantic Regional Fisheries Office (Table 5.2-10; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007) were used in modeling that assumed no animal movement (Limpert et al. 2024). Although some fish may move away from sound during pile driving, for modeling purposes they were considered static receivers. Therefore, acoustic distances where sound levels could exceed fish sound thresholds were determined using a maximum-over-depth approach and finding the distance that encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified level. Additional modeling details of foundation installation scenarios can be found in Section 5.2.2.

Based on modeled results, the distance to pile driving sound levels that could exceed recommended Atlantic sturgeon injury thresholds (fish ≥ 2 grams = 206 decibel SPL_{pk}) is 0.09 miles (0.15 kilometers) for single strikes and within up to 6.03 miles (9.7 kilometers) for cumulative exposure (187 decibels SEL_{cum}) during monopile driving, assuming 10 dB of noise attenuation (Table 5.2-11). During pin pile driving, the distance to pile driving sound levels that could exceed recommended Atlantic sturgeon injury thresholds (206 decibel SPL_{pk}) is 0.04 miles (0.06 kilometers) for post-piled jacket pin pile driving and 0.03 miles (0.05 kilometers) for pre-pile jacket pin pile driving for single strikes and within up to 5.1 miles (8.2 kilometers) for post-piled jacket pin pile driving and 4.2 miles (6.8 kilometers) for pre-piled jacket pin pile driving for cumulative exposure (187 decibels SEL_{cum}) with 10 dB of noise attenuation. Lower exposure ranges were reported at Location 2 and during the summer. Based on these results, to be exposed to potentially injurious levels of noise during pile driving, the Atlantic sturgeon would need to be within 4.2 to 6.03 miles (6.8 to 9.7 kilometers) of the pile being driven for a prolonged period. This is unlikely to occur as the Atlantic sturgeon would be expected to quickly move away from the ensonified area before injury levels are reached.

Behavioral effects, such as avoidance or disruption of foraging activities, may occur in Atlantic sturgeon exposed to noise above 150 decibels SPL_{rms}. Sound levels could exceed this behavioral threshold within 6.03 – 10.69 miles (9.7 – 17.2 kilometers) of monopile driving and within 5.16 – 8.08 miles (8.34 – 13 kilometers) of post-piled pin pile driving and 4.56 – 6.71 miles (7.34 – 10.8 kilometers) for pre-piled pin pile driving, assuming 10 dB of noise attenuation, and depending on season and location (lower exposure ranges at L02 and in summer, and higher at L01 and in winter). It is reasonable to assume that the Atlantic sturgeon, upon detecting underwater noise levels at or above these thresholds, would modify its behavior such that it redirects its course of movement away from the ensonified area surrounding the activity.

Table 5.2-11. Summary of acoustic radial distances (R95% in kilometers) for fish during monopile impact pile installation at the higher impact of two modeled locations for both seasons, with 10 dB noise attenuation from a noise abatement system

Fish ≥ 2 grams	Location 1			Location 2		
	Injury [a] L_{pk}	Injury [a] L_E	Behavior [b] L_p	Injury [a] L_{pk}	Injury [a] L_E	Behavior[b] L_p
Range (km) during Winter						
16 m Monopile Scenario, NNN 6600 (b) hammer	0.15	9.68	17.22	0.11	7.69	12.35
4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer	0.06	8.21	13.02	0.06	6.30	11.07

Fish ≥ 2 grams	Location 1			Location 2		
	Injury [a] L_{pk}	Injury [a] L_E	Behavior [b] L_p	Injury [a] L_{pk}	Injury [a] L_E	Behavior[b] L_p
4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	0.05	6.83	10.79	0.05	5.36	9.11
Range (km) during Summer						
16 m Monopile Scenario, NNN 6600 (b) hammer	0.14	8.50	13.86	0.11	6.51	9.69
4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer	0.06	7.34	10.99	0.06	5.48	8.34
4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	0.05	6.31	9.28	0.05	4.77	7.34

km = kilometer; m = meter; dB = decibel
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}
Sources:
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
Source: Summarized from Tables 50 – 55 in Limpert et al. (2024)

A range of mitigation and monitoring measures, including reporting protocols (BA-12, BA-28), will be implemented to minimize the effects of pile driving noise on fish (Section 3.3, Table 3.3-2). These include enforcing appropriate monitoring and exclusion zones (BA-23, BA-25) and implementing soft-start procedures (BA-18) to minimize the potential for exposure leading to injury or behavioral disturbance. Soft starts would facilitate a gradual increase of hammer blow energy and would be effective in deterring Atlantic sturgeon from impact pile driving activities prior to exposure that would result in serious injury. The soft start procedure must include a minimum of 20 minutes of 4-6 strikes/minute at 10-20 percent of the maximum hammer energy (BA-18). A sound field verification plan (SFVP) will allow for adaptive monitoring and the adjustment of clearance zones, as needed, based on reported field measurements (BA-19 and BA-20). The potential for serious injury is also minimized by using a noise attenuation system (NAS) during all impact pile-driving operations (BA-24). A combination of NAS (e.g., double big bubble curtain, hydrodsound damper plus single big bubble curtain) are reasonably expected to achieve far greater than 10 dB broadband attenuation of impact pile driving sounds. With these measures in place, injuries to fish are expected to be minimal. While some fish are expected to experience behavioral effects within the ensonified area, these effects would be temporary, as fish are expected to resume normal behaviors following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018). Impacts from injurious sound are expected to be short term and localized.

Atlantic sturgeon individuals will likely be present intermittently, moving through the Lease Area throughout their spring and fall migrations, and may forage opportunistically where benthic invertebrates are present. The Project area is not known to be a preferred foraging area and has not been identified as an aggregation area which reduces the potential for impact on this species from pile driving noise. Atlantic sturgeon could be exposed to noises above behavioral thresholds and may avoid the area; however, access to preferred foraging, spawning or overwintering areas would not be affected, and only cessation of opportunistic foraging areas during migration period is expected. Should an exposure occur, it would be temporary with effects dissipating once the activity had ceased or the individual had left the area. Any behavioral effects would be temporary and limited to the small area ensonified with sound levels above the behavioral threshold.

Given the dispersed distribution of Atlantic sturgeon in the Lease Area, the extremely unlikely potential for co-occurrence in time and space given the small area where exposure to peak noise could occur, and the anticipated avoidance of disturbing levels of sound, effects of exposure to sound levels above injury or behavioral thresholds is considered **discountable**. Therefore, the effects of noise exposure from Project impact pile driving leading to injury or behavioral disturbance **may affect**, **not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.2.3 Geotechnical and Geophysical Surveys

Geotechnical and geophysical (G&G) surveys for the Proposed Action would occur prior to installation of offshore cables and during the O&M phase of the Project (Section 3.1.2.7). Such surveys can generate high-intensity, impulsive or intermittent noise that has the potential to result in physiological or behavioral effects in aquatic organisms. G&G surveys for the Proposed Action include HRG surveys. Compared to other G&G survey equipment, HRG survey equipment produces less-intense noise and operates in smaller areas.

During construction, it is estimated that 2,485.5 miles (4,000 kilometers) of HRG surveys will occur within the Lease Area and 3,106.8 miles (5,000 kilometers) will occur along the ECCs. Assuming 50 miles (80 kilometers) is surveyed per day, that results in 50 days of survey activity in the Lease Area and 62.5 days of survey activity along the ECCs. Multiplying the daily ensonified area by the number of days of survey activity within each area results in a total ensonified area of 702.1 square miles (1,130 square kilometers) in the Lease Area and 877.7 square miles (1,413 square kilometers) along the ECCs.

HRG surveys will be carried out on a routine basis during the 3 years following the first 2 years of construction, which is termed the “operations phase” in the Project’s ITR (LGL 2024). This 3-year period differs from the operations and maintenance (O&M) phase of the Project that will follow for the remaining life of the Project. On an annual basis during construction operations period, it is estimated that 1,739.8 miles (2,800 kilometers) of HRG surveys will occur within the Lease Area and 1,988.4 miles (3,200 kilometers) will occur within the ECCs. Assuming 50 miles (80 kilometers) is surveyed per day, this results in 35 days of survey activity in the Lease Area and 40 days of survey activity with the ECCs each year. Multiplying the daily ensonified area by the number of days of survey activity within each area results in an annual ensonified area of 491.5 square miles (791 square kilometers) in the Lease Area and 561.7 square miles (904 square kilometers) with the ECCs. Over the three years of construction operations that would occur during the five-year period covered by the requested regulations, the total ensonified area in the Lease Area would be 1,474.5 square miles (2,373 square kilometers) and within the ECCs would be 1,685.2 square miles (2,712 square kilometers).

5.2.3.1 Marine Mammals

Geotechnical and geophysical survey noise may affect marine mammals through auditory injuries, stress, disturbance, and behavioral responses. HRG survey equipment have the potential to be audible to marine mammals (MacGillivray et al. 2014) including equipment with operating frequencies below 180 kilohertz.

To estimate distances to threshold levels, acoustic propagation modeling was undertaken by JASCO Applied Sciences (Li and Denes, 2020) based on manufacturer-provided source levels and operational parameters for HRG equipment that are currently being considered under the Proposed Action. A summary of the specification for representative equipment that was used in the modeling is presented in Table 5.2-12. Equipment with operating frequencies above 180 kilohertz were not considered in the modeling as they are above the hearing ranges of all listed species and are therefore not anticipated to cause injury or disturbance.

Table 5.2-12. Representative HRG survey equipment and operating frequencies

Equipment Type	System	Operating Frequency (kHz)	Source Level (dB)		Beamwidth (º)
			L_{pk}	L_p	
Sparker	SIG ELC 820 @ 750 J	0.01 – 1.9	213	203	180 (assumed omnidirectional)
Sub-bottom profiler	Teledyne Benthos Chirp III	2 – 7	204	199	82
Boomer	Applied Acoustics S-boom @ 700 J	0.01 – 5	211	205	61

dB = decibel; kHz = kilohertz
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{rms} or L_{rms}
Source: Summarized from Table 38 MMPA ITA (LGL 2024) and Tables 2, 4, and 6 (Li and Denes 2020)

The largest horizontal impact distances for marine mammals based on the representative geophysical survey equipment were calculated and shown in Table 5.2-13. Based on the modeling output, the largest distance to a PTS (Level A) threshold from a sparker, sub-bottom profiler, or boomer source for low frequency cetaceans is less than 33 feet (10 meters). The largest modeled distance to the behavioral harassment threshold (Level B) was 463 feet (141 meters) from a sparker. Although a sparker may not be used at all times during HRG surveys, this distance was used in calculating the area exposed to sounds above 160 dB SPL_{rms} for all HRG survey activity to provide a conservative estimate of sound exposure. This was done by assuming an average of 50 miles (80 kilometers) of survey activity would be completed daily by each survey vessel when active. A 463-feet (141 meters) perimeter around 50 miles (80 kilometers) of survey line was calculated to estimate a daily ensonified area of 8.7 square miles (22.6 square kilometers).

Table 5.2-13. Summary of Level A (SEL_{cum}) and Level B (SPL_{rms}) horizontal impact distances (meters)

Equipment	System	Level A horizontal impact distance (m) for LFC		Level A horizontal impact distance (m) for MFC		Level B horizontal impact distance (m)
		L_{pk}	L_E	L_{pk}	L_E	
Sparker	SIG ELC 820 @ 750 J	-	1	-	< 1	141
Sub-bottom profiler	Teledyne Benthos Chirp III	-	2	-	< 1	66
Boomer	Applied Acoustics S-boom @ 700 J	-	< 1	-	< 1	90

dash (—) indicates the HRG equipment source level is below the relevant threshold level
LFC = low frequency cetacean group; MFC = mid-frequency cetacean group; m = meters
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
Source: Summarized from Table 35 MMPA ITA (LGL 2024)

Based on the model results, PTS from Level A exposures could only occur if marine mammals are close to survey activities and remain within 3.3 – 6.6 feet (1 – 2 meters) of the equipment while it's in use for 24 hours. Therefore, HRG survey equipment is unlikely to result in injury given that sound levels diminish rapidly with distance from the survey equipment (BOEM 2018c).

Due to the range of frequencies emitted during HRG surveys, behavioral disturbance and masking are considered possible in all functional hearing groups. This is particularly the case for omnidirectional and high-amplitude sources such as some boomers and sparkers. However, for most HRG survey equipment, the restricted beam shape and directionality (i.e., energy is pointed downwards) of signals and the brief period when an individual mammal may be within its beam may reduce the potential for behavioral disturbance (NOAA 2021). Masking of LFC communications is considered more likely due to the overlap of these surveys with lower-frequency signals produced by these species. Masking of high-frequency echolocation clicks used by MFCs and HFCs is not anticipated; however, some masking of other communication used by these species is possible.

To calculate potential Level B exposures from HRG surveys within the Lease Area and the ECC, the annual average marine mammal densities in Table 5.2-14 were multiplied by the total expected ensonified area. This value was then compared against the PSO data take estimate and the mean group size of each species and the largest value was selected as the annual estimated exposure (Years 1 and 2). The annual estimated exposure was then multiplied by three to calculate the total exposures over the three years of operations (Years 3 to 5). The estimated exposure for ESA-listed whales during construction and operations are shown in Table 5.2-15 and Table 5.2-16, respectively. The greatest Level B exposure during construction is four NARWs and six fin whales in Year 1 and four NARWs and six fin whales in Year 2. Over the 3-year operations phase, up to 15 NARWs and 12 fin whales may be exposed to levels of sound inducing behavioral effects. Thus, a conservative estimate of up to 23 NARWs and 30 fin whales may experience behavioral effects from HRG survey activities. No Level A exposures leading to injury are anticipated for HRG surveys during the construction or operations phase.

Table 5.2-14. Annual average marine mammal densities within 10 km (6.2 mi) of the Lease Area and within 5 km (3 mi) of the ECCs.

Species	Annual Average Density (individuals/km^2)	
	Lease Area	ECC
Blue whale	0.0000	0.0000
Fin whale	0.0022	0.0008
NARW	0.0027	0.0023
Sei whale	0.0006	0.0003
Sperm whale	0.0005	0.0001

ECC = export cable corridor; km = kilometer; km^2 = square kilometer; mi = miles
Source: Table 31 and Table 33 MMPA ITA (LGL 2024)

Table 5.2-15. Estimated Level B exposures for ESA-listed marine mammals from HRG surveys during the Construction Phase (Year 1 and Year 2)

Species	Density-based Exposures by Survey Area Year 1			Density-based Exposures by Survey Area Year 2			PSO Data-based Exposure Estimate	Mean Group Size	Total Level B Exposure (Construction Phase)	
	Lease Area	ECC	Annual Total	Lease Area	ECC	Annual Total			Year 1	Year 2
Blue whale	0.0	0.0	0.0	0.0	0.0	0.0	-	1.0	1	1
Fin whale	1.2	0.6	1.8	1.3	0.6	1.8	5.3	1.8	6	6
Sei whale	0.3	0.2	0.5	0.4	0.2	0.6	1.4	1.6	2	2
NARW	1.5	1.6	3.1	1.5	1.7	3.2	-	2.4	4	4
Sperm whale	0.3	0.1	0.3	0.3	0.1	0.3	0.4	2.0	2	2

ECC = export cable corridor; PSO = protected species observer
Source: Summarized from Table 40 MMPA ITA (LGL 2024)

Table 5.2-16. Estimated Level B exposures for ESA-listed marine mammals from HRG surveys during the Operations Phase (Years 3 to 5)

Species	Annual Operations Phase Exposure by Survey Area (Years 3 – 5)		Annual Total Density-based Exposure Estimate	Annual PSO Data-based Exposure Estimate	Mean Group Size	Highest Annual Level B Exposure	3-Year Level B Exposure (Operations Phase)
	Lease Area	ECC					
Blue whale	0.0	0.0	0.0	-	1.0	1	3
Fin whale	1.8	0.7	2.5	3.6	1.8	4	12
Sei whale	0.5	0.3	0.7	0.9	1.6	2	6
NARW	2.1	2.1	4.2	-	2.4	5	15
Sperm whale	0.4	0.1	0.5	0.3	2.0	2	6

ECC = export cable corridor; PSO = protected species observer
Source: Summarized from Table 41 MMPA ITA (LGL 2024)

A range of mitigation measures will be implemented for HRG survey activities when operating equipment that produces sound within marine mammals' hearing range (i.e., less than 180 kilohertz) (Section 3.3, Table 3.3-1 and Table 3.3-2). These measures include compliance with all PDC and BMPs for site assessment and characterization activities (BA-2). During HRG surveys, 1,640-foot (500-meter) monitoring zones for baleen whales and 328-foot (100-meter) monitoring zones for other marine mammals would be used 30 minutes prior to noise-producing survey activities. Any marine mammals observed in these zones would pause the 30-minute observation period, which would resume only after confirmation from the observer that the animal has left the area. If the animal dives or visual contact is lost, the 30-minute observation period is reset (BOEM 2021c). During survey activities, 656-foot (200-meter) shutdown zones for baleen whales and 328-foot (100-meter) shutdown zones for all other marine mammals would be established. Observed animals occurring within these ranges would prompt a shutdown of boomers or sparkers until the animal leaves the area (BOEM 2021d). These measures require the use of PSOs to monitor and enforce clearance and shutdown zones around HRG survey activities and utilization of ramp-up procedures prior to commencement of survey activities, further reducing the likelihood of marine mammal injury. Any behavioral impacts on individual ESA-listed marine mammals associated with G&G surveys for the Proposed Action would be temporary and are not expected to result in stock or population-level effects.

Based on modeling, Level A thresholds in the areas ensonified by all anticipated HRG survey equipment would not be reached during early or late construction periods. Therefore, noise exposure leading to PTS is not expected for any ESA-listed species during HRG surveys, thus there is **no effect**.

During early and late construction periods, behavioral disturbance through Level B exposures to noise are possible. However, due to the small ensonified area from HRG survey equipment (463 feet [141 meters] or less, depending on equipment) wherein sound exposure would be brief and temporary, along with the implementation of monitoring and shutdown zones (328– 1,640 feet [100 – 500 meters]) that would more than cover the behavioral disturbance area, the potential for exposure of these ESA-listed species to noise levels leading to behavioral disruption would be reduced at the level of the individual animal and would not be expected to have population level effects. Individual effects would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Given the low number of potential exposures during all phases of the Project, the effects of noise exposure from Project HRG surveys leading to behavioral disturbance and masking **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.2.3.2 Sea Turtles

Noise from G&G surveys has the potential to affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. However, sea turtles would have to be very near G&G survey activity to experience injury-level exposures (PTS/TTS). Due to the short duration and mobile nature of survey activity, it is unlikely G&G surveys would result in injury as sea turtles would likely avoid these temporarily disturbed areas. Low level behavioral exposures could occur; however, these disruptions would be limited in extent and duration and would have short-term effects on both the individual and population.

G&G surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range (e.g., multibeam echosounders, side scan sonar). BOEM (2021) evaluated potential underwater noise effects on sea turtles from G&G surveys using impulsive sources (e.g., boomers, bubble guns, air guns, sparkers, etc.) and concluded that for an individual sea turtle to experience a behavioral response threshold of SPL greater than 175 dB re 1 μPa, it would have to be within 295 feet (90 meters) of a sparker or the loudest G&G sound source. In fact, NMFS (2021c) states that none of the equipment being operated for HRG surveys—with frequencies that overlap with sea turtles' hearing—has source levels loud enough to result in permanent PTS. However, noise from impulsive sources used during HRG surveys could exceed the behavioral effects threshold (SPL: 175 dB re 1 µPa) within 105 – 118 feet (32 – 36 meters) from the source, based on the boomer and sparker systems proposed for the Project (NMFS 2021c).

Given the limited spatial extent of potential noise effects, injury-level exposure (PTS) is unlikely to occur. Based on the speed of the survey vessels, and the lower noise levels and smaller operational scales of G&G survey equipment, G&G surveys associated with the Proposed Action are unlikely to result in injury of any ESA-listed sea turtles in the Action Area. Should an exposure occur, the potential effects would be brief (e.g., a sea turtle may approach the noisy area and divert away from it), and any effects of this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**.

A range of mitigation and monitoring measures will be implemented for HRG surveys, which include pre-clearance zones, shutdown zones, and ramp-up procedures (Section 3.3, Table 3.3-2, BA-2). Pre-clearance and shutdown zones for sea turtles are set at 328 feet (100 meters) which is more than three times larger than the distance identified as exceeding the sea turtle behavioral threshold for the proposed boomer and sparker equipment. Monitoring this zone for sea turtles is considered highly effective in mitigating effects due to noise from HRG surveys. Mitigation measures also include compliance with all PDC and BMPs for site assessment and characterization activities. With the application of these mitigation measures, the potential for ESA-listed sea turtles to be exposed to noise above behavioral thresholds is plausible but considered extremely unlikely to occur and is **discountable**. Sea turtle peak pressure distances for all HRG sources are below the threshold level of 232 dB, so HRG survey sound will not cause PTS or injury to sea turtles, either. Therefore, the effects of noise exposure from Project HRG surveys leading to injury or behavioral effects **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.2.3.3 Fish

Seismic noise from G&G surveys has been shown to create varying behavioral responses in fish. These responses in fishes have been documented but careful evaluations of their impacts and examinations of physiological injury are lacking (Carroll et al. 2016). Behavioral impacts on Atlantic sturgeon from Project-related G&G surveys would also be localized and temporary. Mobile, intermittent, non-impulsive HRG survey sound sources, such as multi-beam echosounders and side-scan sonar, are not likely detectable by Atlantic sturgeon as they operate above the hearing sensitivity of this species (above 1 kilohertz; Table 5.2-12) making the potential for auditory injury and behavioral disturbance unlikely.

For the HRG systems proposed for the Project, the distance to physical injury for fish was 13 feet (4 meters) for the sparker and 8.2 feet (2.5 meters) for the boomer (Table 5.2-17). During HRG surveys using impulsive equipment, finfish and invertebrates close to sparkers and boomers may experience temporary displacement (BOEM 2021e). This type of behavioral impact would be localized to within 1,847 – 2,070 feet (563 – 631 meters) of the sound source and would be short-term in duration. Finfish and invertebrates in the general area but not in the immediate vicinity of the sound source could experience short-term stress and temporary behavioral changes in a larger area affected by the sound.

Table 5.2-17. Summary of impulsive HRG equipment source levels and associated PTS and behavioral disturbance distances for fish.

Equipment	System	Highest Source Level (dB re 1 μPa)		PTS Distance (m) for Fish		Behavioral Disturbance Distance (m) for Fish
		L_{pk}	L_E	L_{pk}	L_E	
Sparker	SIG ELC 820 @ 750 J	213	182	4.0	0	631
Sub-bottom profiler	Teledyne Benthos Chirp III[a]	204	193	NA	NA	32
Boomer	Applied Acoustics S-boom @ 700 J	211	172	2.5	0	563

[a]Measured highest source levels were not provided for this exact system, so used generalized values for chirp sub-bottom profilers from Table 1 in NMFS 2021c.
dB = decibel; HRG = high resolution geophysical; m = meters; PTS = permanent threshold shift
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
NA = not applicable due to the sound source being out of the hearing range for the group
Source: Summarized from Table 1 and Tables A.2 – A.5 (NMFS 2021c)

A range of mitigation and monitoring measures will be implemented that would help reduce the potential for serious injury from HRG survey activities (Table 3.3-2, BA-2). For example, ramp-up procedures would facilitate a gradual increase of equipment energy that would allow the Atlantic sturgeon to avoid the area prior to the start of operations. In addition, as the 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 a survey transect, the potential effects are transient and intermittent.

Considering the very small injury zones, the implementation of ramp-up procedures and the transient nature of the effect, the potential for Atlantic sturgeon to be exposed to noise sources above physiological thresholds is considered extremely unlikely to occur and is **discountable**. Effects of brief exposure above behavioral thresholds could result in temporary displacement from opportunistic feeding areas; however, any impacts associated with this avoidance would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Therefore, the effects of noise exposure from Project HRG surveys leading to physiological injury or behavioral disturbance **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.2.4 Cable Laying

Noise-producing activities associated with cable laying during construction include route identification surveys, trenching, jet plowing, backfilling, and installation of cable protection. There is limited information regarding underwater noise generated by cable-laying and burial activities in the literature. Johansson and Andersson (2012) recorded underwater noise levels generated during a comparable operation involving pipelaying and a fleet of nine vessels. Mean noise levels of 130.5 dB re 1 µPa were measured at 4,921 feet (1,500 meters) from the source. Reported noise levels generated during a jet trenching operation provided a source level estimate of 178 dB re 1 µPa measured at 3.3 feet (1 meter) from the source (Nedwell et al. 2003).

Modeling based on noise data collected during a cable laying operation in Europe estimates that underwater noise levels would exceed 120 decibels referenced to 1 microPascal in a 98,842-acre (400-square kilometer) area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). The affected area associated with cable-laying activities is expected to be smaller than those modeled for other activities, including pile driving and G&G surveys. As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the mobile nature of the ensonified area, a given location would not be ensonified for more than a few hours.

5.2.4.1 Marine Mammals

Noise from cable laying activities is not expected to reach levels that would cause PTS, TTS, or injury to any ESA-listed whales; it might, however, reach levels that exceed thresholds for behavioral effects (120 dB re 1 uPa2 s). Foraging cetaceans are not expected to interrupt foraging activity when exposed to cable-laying noise but may forage less efficiently due to increased energy spent on vigilance behaviors (NMFS 2015). Decreased foraging efficiency could have short-term metabolic effects resulting in physiological stress, but these effects would dissipate once the prey distribution no longer overlaps the mobile ensonified area. Given the mobile nature of the ensonified area and associated temporary ensonification of a given habitat area, it is unlikely that cable-laying noise would result in adverse effects on ESA-listed marine mammals.

For example, during a similar type of underwater construction activity, Robinson et al. (2011) measured sound levels radiated from marine aggregate dredgers, mainly trailing suction hopper dredges during normal operation. Robinson et al. (2011) concluded that because of the operation of the propulsion system, noise radiated at less than 500 hertz, which is similar to that of a merchant vessel "traveling at modest speed (i.e., between 8 and 16 knots)" for self-propelled dredges. During dredging operations, additional sound energy generated by the impact and abrasion of the sediment passing through the draghead, suction pipe, and pump, is radiated in the 1 to 2 kilohertz frequency band. These acoustic components would not be present during cable laying operations, so these higher frequency sounds are not anticipated. Additionally, field studies conducted offshore New Jersey, Virginia, and Alaska show that noise generated by using vibracores and drilling boreholes diminishes below the NFMS behavioral response thresholds (120 decibels for continuous sound sources) relatively quickly and is unlikely to cause harassment to marine mammals (Reiser et al. 2010, 2011; Tetra Tech 2014).

Noise exposure leading to PTS is not expected from cable laying, therefore, there would be **no effect** on ESA-listed marine mammals. As discussed above, NARW, fin whales, sei whales, and sperm whales may be exposed to noise above the behavioral thresholds depending on the type of the vessel and equipment used for cable laying operations. However, the implementation of mitigation and monitoring measures such as visual and acoustic monitoring and vessel separation distances as outlined in Section 3.3, Table 3.3-1,would help reduce the potential for exposure to sound levels above the behavioral disturbance threshold. Noise levels that could potentially lead to behavioral disruption would be reduced at the level of the individual animal and would not be expected to have population level effects. Given the interim definition for ESA harassment, the animal's ability to avoid harmful noises, and the established mitigation and monitoring measures, the potential for ESA-listed marine mammals to be exposed to underwater noise exceeding behavioral disruption thresholds from cable laying operations would not rise to the level of take under the MMPA and is, therefore, considered **insignificant**. Thus, the effects of noise exposure from Project cable laying and trenching operations leading to behavioral disturbance and masking **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.2.4.2 Sea Turtles

Cable-laying noise sources associated with the Project are expected to be below the established PTS injury thresholds for all marine mammal hearing groups as outlined in Section 5.2.4.1 above. As sea turtles are less sensitive to underwater noise than marine mammals, it can be inferred that sea turtles are extremely unlikely to be exposed to noise above PTS thresholds from cable-laying noise sources, therefore, cable-laying noise is expected to have **no effect** on ESA-listed sea turtles.

However, as reported source noise levels generated during cable laying activities (e.g., jet trenching) can range up to 178 dB re 1 µPa-m (Nedwell et al. 2003), cable-laying operations could exceed the disturbance threshold for sea turtles (175 dB re 1 µPa L_{rms}). Popper et al. (2014) suggest that in response to continuous sounds, sea turtles have a high risk for behavioral disturbance in the near field (e.g., tens of meters), moderate risk in the intermediate field (hundreds of meters) and low risk in the far field (thousands of meters). Should sea turtles be exposed to a continuous sound source that exceeds the behavioral threshold for a prolonged period, PTS may occur regardless of distance. As previously noted, the ensonified area associated with cable laying would be dynamic with cable-laying vessels and equipment that are continually moving, thus, a given location would not be ensonified for more than a few hours. Therefore, behavioral effects are considered possible but would be temporary, dissipating once the sea turtle is outside of the ensonified area. Should an exposure occur, the potential effects would be brief (e.g., a sea turtle may approach the noisy area and divert away from it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Further, the implementation of mitigation and monitoring measures such as visual monitoring and vessel separation distances as outlined in Section 3.3, Table 3.3-2 (BA-5, BA-7) would help reduce the potential of such effects. Therefore, the effects of noise exposure from Project cable-laying operations leading to behavioral disturbance **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.2.4.3 Fish

Noise levels associated with cable laying may cause temporary stress and behavioral changes in finfish in the ensonified area but are insufficient to pose a risk of injury or mortality. Because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, any behavioral responses to cable-laying noise are expected to be temporary and localized. No significant impacts on ESA-listed Atlantic sturgeon are expected from noise generated by cable-laying activities.

It is unlikely that received levels of underwater noise from cable-laying operations would exceed physiological injury thresholds for Atlantic sturgeon since the animals would move away from any noise that could result in injury. Thus, the potential for ESA-listed Atlantic sturgeon to be exposed to noise above physiological injury thresholds is considered extremely unlikely to occur and is **discountable**. Therefore, the effects of noise exposure from Project cable-laying operations leading to physiological injury **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

Behavioral effects are considered possible but would be temporary with effects dissipating once the activity has ceased or the animal has left the area. Mitigation and monitoring measures that could minimize the effects of cable-laying noise that includes visual monitoring and vessel separation distances as outlined in Section 3.3, Table 3.3-2 (BA-5, BA-7). Should an exposure occur, the potential effects would be brief (e.g., Atlantic sturgeon may approach the area and divert away from it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Along with the proposed mitigation measures, the effects of noise exposure from Project cable-laying operations leading to behavioral disturbance **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.2.5 Dredging

Dredging would not be required for any foundation type in the Lease Area and is not anticipated for the interarray cable installation. For the export cable installation, dredging is anticipated for the purpose of seabed preparation (sand wave clearance) within five percent of the Falmouth ECC (associated with the Muskeget Channel and Nantucket Sound). Sand wave clearance would be accomplished with a trailing suction hopper dredger or water injection dredge (both hydraulic dredge types) (Section 3.1.2.4.2). Dredging is also expected at HDD offshore exit pits at landfall locations within the Falmouth ECC and Brayton Point ECC.

Hydraulic trailing suction hopper dredging and controlled-flow excavation dredging involve the use of a suction to either remove sediment from the seabed or relocate sediment from a particular location on the seafloor. The sound produced by hydraulic dredging results from the combination of sounds generated by the impact and abrasion of the sediment passing through the draghead, suction pipe, and pump. The frequency of the sounds produced by hydraulic suction dredging ranges from approximately 1 to 2 kilohertz, with reported source levels of 172 to 190 dB re 1 μPa at 3.3 feet (1 meter) (Robinson et al. 2011; Todd et al. 2015; McQueen et al. 2019). Robinson et al. (2011) noted that the level of broadband noise generated by suction dredging is dependent on the aggregate type being extracted, with coarse gravel generating higher noise levels than sand. Noise produced by mechanical dredging is emitted from winches and derrick movement, bucket contact with the substrate, digging into substrate, bucket closing, and emptying of material into a barge or scow (Dickerson et al. 2001). Reported sound levels of clamshell dredges include 176 dB re 1 μPa Lrms (BC MoTI 2016) and 107 to 124 dB re 1 μPa at 505 feet (154 meters) from the source with peak frequencies of 162.8 Hz (Dickerson et al. 2001; McQueen et al. 2019). Maximum levels occurred when the dredge bucket made contact with the channel bottom in mixed coarse sand or gravel (Dickerson et al. 2001; McQueen et al. 2019).

5.2.5.1 Marine Mammals

Based on the available source level information presented above, hydraulic and mechanical dredging are unlikely to exceed ESA-listed marine mammals PTS thresholds and therefore there is **no effect**. If dredging occurs in one area for relatively long periods, behavioral thresholds could be exceeded along with masking of marine mammal communications (Todd et al. 2015; NMFS 2018a). Behavioral responses of marine mammals to dredging activities have included avoidance in bowhead whales, gray whales, minke whales, and gray seals (Bryant et al. 1984; Richardson et al. 1990; Anderwald et al. 2013). Diederichs et al. (2010) found short-term avoidance of dredging activities by harbor porpoises near breeding and calving areas in the North Sea. Pirotta et al. (2013) found that, despite a documented tolerance of high vessel presence, as well as high availability of food, bottlenose dolphins spent less time in the area during periods of dredging. The study also showed that with increasing intensity in the activity, bottlenose dolphins avoided the area for longer durations (with one instance being as long as 5 weeks; Pirotta et al. 2013).

Dredging that will occur in the Project area would likely not extend into Nantucket Shoals, the area where the greatest densities of ESA-listed marine mammals are found. Timing of NARW migrations includes a northward migration during March – April and a southward migration during November – December between summer feeding and winter calving grounds. During this migration period adults may be accompanied by calves and periodically feed and rest along their migration route. Fin whales are present in the area year-round. Fin whales, sei whales, and blue whales generally prefer the deeper waters of the continental slope and more often can be found in water greater than 295 feet (90 meters) deep (Hain et al. 1985; Waring et al. 2011; Hayes et al. 2020). The nearshore dredging activities are less likely to interact with blue and sei whales as these species are rarely observed in nearshore waters. As mentioned in the studies discussed above, LFCs such as bowhead whales, gray whales, minke whales have been documented to exhibit short-term avoidance of dredging activities, therefore, behavioral disturbance is possible. However, any behavioral effects would be expected to dissipate once the activity ceases or individual has left the area and is therefore considered temporary. The exact duration or number of dredging events required to support the Project are unknown at this time. Behavioral disturbance from dredging is not expected to impede the migration of NARWs to critical habitats located to the north and south of the Project area as animals would be able to travel in areas undisturbed by Proposed Action activities. LFCs would be expected to resume pre-exposure activities once the activity stopped or the animal moved out of the disturbance zone.

The energetic consequences of any avoidance behavior or masking effects and potential delay in resting or foraging 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 calving. Any such effects to underwater noise exceeding behavioral disturbance thresholds from dredging operations would be too small to be meaningfully measured, detected, or evaluated and is considered **insignificant.** Therefore, the effects of noise exposure from Project dredging leading to behavioral disturbance **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.2.5.2 Sea Turtles

Based on the available source level information presented above, hydraulic and mechanical dredging are unlikely to exceed turtle PTS thresholds and therefore there is **no effect** for all sea turtles.

If dredging occurs in one area for relatively long periods, noise exposure exceeding behavioral thresholds could be possible. As discussed above, there is very little information regarding the behavioral responses of sea turtles to underwater noise. Popper et al. (2014) suggests that in response to continuous sounds, sea turtles have a high risk for behavioral disturbance in the near field (e.g., tens of meters), moderate risk in the intermediate field (hundreds of meters) and low risk in the far field (thousands of meters). The potential risk for injury and TTS is considered low at all distances for continuous / non-impulsive noise (Popper et al. 2014), like dredging.

Behavioral effects are considered possible but would be temporary with effects dissipating once the activity has ceased or the individual has left the area. Should an exposure occur, the potential effects would be brief (e.g., a sea turtle may approach the noisy area and divert away from it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Therefore, the effects of noise exposure from Project dredging operations leading to injury or behavioral disturbance **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.2.5.3 Fish

It is unlikely that received levels of underwater noise from dredging operations would exceed physiological injury thresholds for Atlantic sturgeon since the animals would move away from any noise that could result in injury. Thus, the potential for ESA-listed Atlantic sturgeon to be exposed to noise above physiological injury thresholds is considered extremely unlikely to occur and is **discountable**.

If dredging occurs in one area for relatively long periods, noise exposure exceeding behavioral thresholds could be possible. Behavioral responses of fish to dredging noise are expected to be similar to responses to vessel noise, which include changes in swimming speed, direction, or depth, avoidance, and changes in schooling behaviors as described in Section 5.3.1.3. Behavioral effects associated with dredging noise are considered possible but would be temporary with effects dissipating once the activity has ceased or an individual has left the area. Should an exposure occur, the potential effects would be brief (e.g., Atlantic sturgeon may approach the area and divert away from it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Therefore, the effects of noise exposure from Proposed Action dredging operations leading to injury or behavioral disturbance **may affect, not likely to adversely** affect ESA-listed Atlantic sturgeon.

5.2.6 UXO Detonation

SouthCoast Wind may encounter UXO on the seabed in the Project area. The Falmouth ECC does not overlap any UXO areas or former defense sites; however, Brayton Point ECC intersects one formerly used defense site. The Lease Area does not coincide with any UXO site, and the nearest site is 10 miles (16 kilometers) west of the Massachusetts and Rhode Island WEA (COP Volume 2, Section 14.1.1; SouthCoast Wind 2023). The exact number and type of UXOs in the Project area are not yet known. As a conservative approach, it is currently assumed that up to five UXOs in the Lease Area and up to five along the ECCs may have to be detonated in place. Several alternative strategies will first be considered prior to detonating a UXO in place. These strategies may include relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). If such alternatives are not possible, UXOs may need to be removed by controlled explosive detonation.

Modeling the acoustic fields generated by UXO detonations was undertaken by JASCO Applied Sciences (Hannay and Zykov 2022) using a combination of semi-empirical and physics-based computational models. To capture a range of potential UXOs, five categories or "bins" of net explosive weight established by the U.S. Navy (U.S. Navy 2017a) were selected for acoustic modeling (Table 5.2-18).

Sound propagation away from detonation sources is affected by acoustic reflections from the sea surface and seabed. Water depth and seabed properties will influence the sound exposure levels and sound pressure levels at distance from detonations. Their influence is complex but can be predicted accurately by acoustic models. Such modeling was conducted at five representative sites (S1 to S5) within the SouthCoast Wind Project area (two along the eastern ECC, one on the western ECC, and two in the Lease Area) (Figure 5.2-2). The modelled water depths at each site ranged from 148-197 feet (45-60 meters) in the Lease Area and 33-98 feet (10-30 meters) in the two ECCs.

Table 5.2-18. Navy "bins" and corresponding maximum charge weights (equivalent TNT) modeled

Navy Bin Designation	Maximum Equivalent Weight (TNT) in Kilograms	Maximum Equivalent Weight (TNT) in Pounds
E4	2.3	5
E6	9.1	20
E8	45.5	100
E10	227.0	500
E12	454.0	1000

TNT = trinitrotoluene
Source : Table 40 MMPA ITA (LGL 2024)

Sound propagation away from detonation sources is affected by acoustic reflections from the sea surface and seabed. Water depth and seabed properties will influence the sound exposure levels and sound pressure levels at distance from detonations. Their influence is complex but can be predicted accurately by acoustic models. Such modeling was conducted at five representative sites (S1 to S5) within the SouthCoast Wind Project area (two along the eastern ECC, one on the western ECC, and two in the Lease Area) (Figure 5.2-2). The modelled water depths at each site ranged from 148-197 feet (45-60 meters) in the Lease Area and 33-98 feet (10-30 meters) in the two ECCs.

For UXO detonations, the calculation of SEL and SPL levels is dependent on the entire pressure waveform, including the initial shock pulse and the subsequent oscillation of the gas bubble. The negative phase pressure troughs and bubble pulse peaks following the shock pulse are responsible for most of the low frequency energy of the overall waveform. The SEL and SPL thresholds for injury and disturbance occur at distances of many water depths in the relatively shallow waters of the Project area. As a result, the sound field becomes increasingly influenced by the contributions of sound energy reflected from the sea surface and sea bottom multiples times. To account for this, the modeling was carried out in decidecade frequency bands using JASCO Applied Sciences' Marine Operations Noise Model (MONM). This model applied a parabolic equation approach for frequencies below 4 kilohertz and a Gaussian beam ray trace model at higher frequencies. In this location, sound speed profiles changed little with depth, so these environments do not have strong seasonal influence on sound propagation. The propagation modeling was performed using a sound speed profile representative of September, which is slightly downward refracting and therefore conservative, and represents the most likely time of year for UXO removal activities.

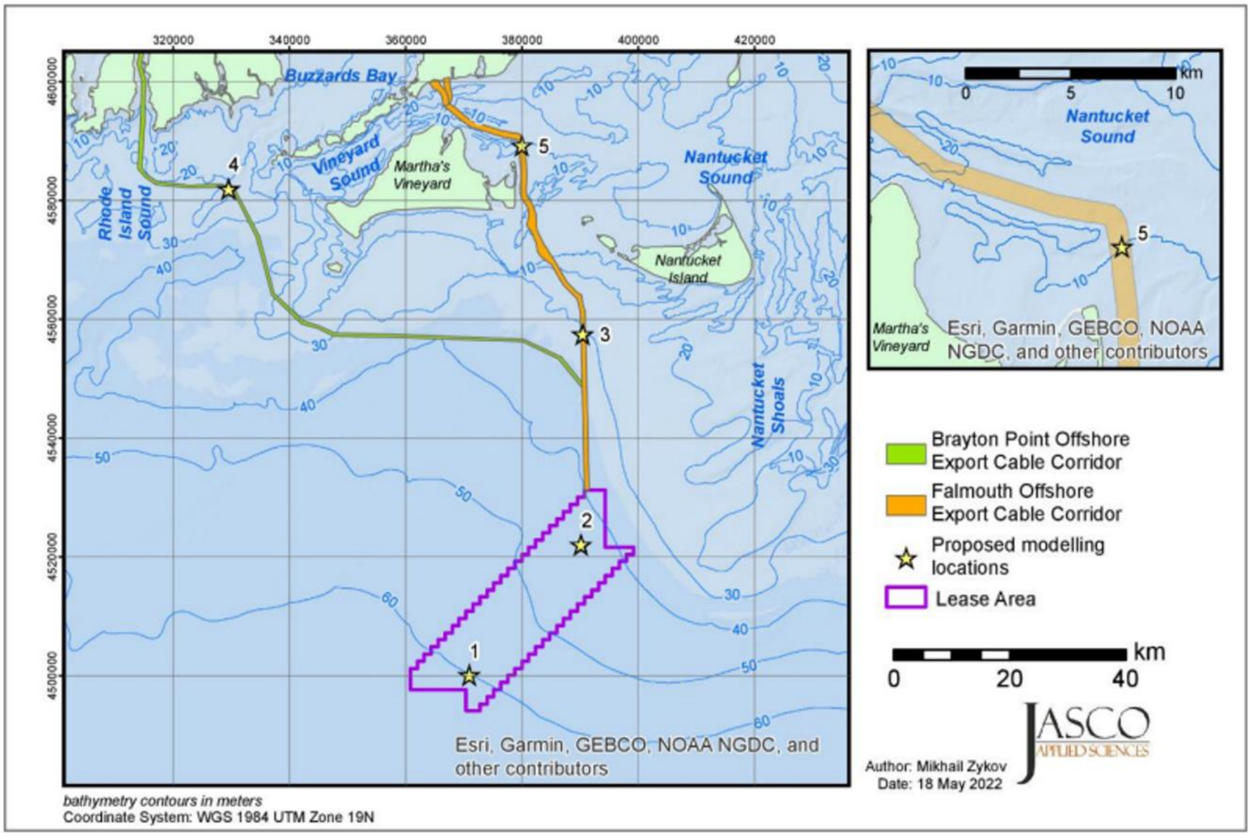

Figure 5.2-2. Locations of UXO acoustic modeling sites in the Lease Area and ECC

In the case of potential UXO detonations, additional thresholds for mortality and non-auditory injury to lung and gastrointestinal organs from the blast shock wave and/or onset of high peak pressures are also relevant (at relatively close ranges). These criteria have been developed by the U.S. Navy (U.S. Navy 2017a) and are based on the mass of the animal and the depth at which it is present in the water column. This means that specific decibel levels for each hearing group are not provided and instead the criteria are presented as equations that allow for incorporation of specific mass and depth values. A conservative equation is available reflecting the onset (1 percent chance) of experiencing the potential effects (Table 5.2-19). The results from these equations were used in the subsequent analyses.

Table 5.2-19. U.S. Navy impulse and peak pressure threshold equations for estimating at what levels marine mammals and sea turtles have a 1% probability of experiencing mortality or non-auditory injury due to underwater explosions (U.S. Navy 2017a).

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

dB = decibel ; M = animal mass in kilograms (kg) ; D = animal depth in meters (m)
Source : Table 7 MMPA ITA (LGL 2024)

5.2.6.1 Marine Mammals

Underwater explosions from UXO detonations generate high pressure levels that could cause disturbance and injury to marine mammals. The physical range at which injury or mortality could occur will vary based on the amount of explosive material in the UXO, size of the animal, and the location of the animal relative to the explosive. Injuries may include physical (non-auditory) injury such as hemorrhages or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries. The behavioral response of marine mammals to UXO detonations is relatively unknown. For marine mammals that are at a distance but within hearing range of the blast, behaviors could include a short startle response, temporarily displacing LFCs that are migrating or foraging. The response would likely be brief, and the animal would be expected to resume pre-detonation activities.

Potential impacts to marine mammals from underwater explosions are assessed using separate criteria for mortality, non-auditory injury, gastrointestinal injury, auditory injury, and behavioral responses. The largest ranges to the thresholds for the ECC and Lease Area sites were selected for each UXO size class and marine mammal size class or hearing group. In all cases, distance to mortality, non-auditory lung injury, and gastrointestinal injury thresholds (Table 5.2-20) were shorter than to auditory injury thresholds (Table 5.2-21).

Table 5.2-20. Ranges (meters) to the onset of mortality, non-auditory lung injury, and gastrointestinal (GI) injury thresholds in the Lease Area and ECCs for five UXO size classes assuming 10 dB of noise attenuation for baleen and sperm whales.

Range per UXO Charge Size	Mortality				Non-Auditory Lung Injury				GI Injury
	ECC		Lease Area		ECC		Lease Area		L_{pk} threshold 237 dB re 1 µPA
	Calf	Adult	Calf	Adult	Calf	Adult	Calf	Adult	
E4 R95% Distance (m)	5	5	5	5	6	5	5	5	21
E6 R95% Distance (m)	6	5	5	5	17	5	14	5	34
E8 R95% Distance (m)	23	6	18	5	54	16	45	13	58
E10 R95% Distance (m)	69	22	63	18	153	51	156	44	99
E12 R95% Distance (m)	108	34	108	29	226	81	242	78	125

dB = decibel; ECC = export cable corridor; GI = gastrointestinal; m = meter; UXO = unexploded ordnance
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
GI injury combines ECC and Lease Area, Calf/Pup and Adult. Thresholds are based on animal mass and submersion depth.
Source: Summarized from Tables 45 – 49 MMPA ITA (LGL 2024) and Tables 34 – 39 (Hannay and Zykov 2022)

Since the size and type of UXOs that may be detonated are currently unknown, all area of impact calculations were made using the largest UXO size class (E12). The E12 ranges to Level A and Level B exposure thresholds within the ECC were used as radii to calculate the area of a circle (pi × r^2 where r is the range to the threshold level) for each marine mammal hearing group. The results represent the largest area potentially ensonified above threshold levels from a single detonation within the Lease Area and the ECC and are shown in Table 5.2-20. The same method was used to calculate the maximum area potentially ensonified above threshold levels from a single detonation as shown in the last row of Table 5.2-21.

Table 5.2-21. Range (km) to Level A and Level B exposure SEL PTS-onset and SEL TTS-onset thresholds in the ECC and Lease Area for LFC (183 dB re 1 μPa·s) and MFC (Sperm whale) (185 dB re 1 μPa·s) for 5 UXO charge sizes assuming 10 dB of noise attenuation, and the maximum area exposed above the threshold

Range per UXO Charge Size	ECC (LFC)		Lease Area (LFC)		ECC (MFC)		Lease Area (MFC)	
	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
E4 R95% Distance (km)	0.72	2.74	0.34	2.82	0.06	0.41	<0.05	0.45
E6 R95% Distance (km)	1.46	4.45	0.78	4.68	0.11	0.71	<0.05	0.77
E8 R95% Distance (km)	2.86	7.21	1.75	7.49	0.24	1.23	0.09	1.24
E10 R95% Distance (km)	4.16	10.3	3.33	10.5	0.47	2.03	0.28	2.12
E12 R95% Distance (km)	4.84	11.8	4.30	11.9	0.60	2.48	0.32	2.55
Single Detonation Maximum Area (km^2)	73.6	437	58.1	445	1.10	19.3	0.30	20.4

dB = decibels; ECC = export cable corridor; km = kilometer; km^2 = square kilometer; LFC = low frequency cetaceans; MFC = mid frequency cetaceans; PTS = permanent threshold shift; TTS = temporary threshold shift
Source: Summarized from Tables 46 – 48 MMPA ITA (LGL 2024) and Tables 46 – 55 (Hannay and Zykov 2022)

Since detonations would likely occur within a relatively short period of time (e.g., one month), using the annual average densities calculated for HRG surveys may underestimate the actual densities of some species during the month that detonations take place. Instead, for the UXO acoustic propagation models, the highest average monthly density for each species from May through November from within 9.3 miles (15 kilometers) of the ECCs and Lease Area was used in the estimates of potential exposures (Table 5.2-22).

Table 5.2-22. Maximum average monthly marine mammal densities within 15 km (9.32 mi) of the Lease Area and the ECC from May through November and the month in which the maximum density occurs for each marine mammal species.

Species	Lease Area		ECC	
	Maximum Monthly Density (individuals/km^2)	Maximum Density Month	Maximum Monthly Density (individuals/km^2)	Maximum Density Month
Blue whale	0.0000	Annual	0.0000	Annual
Fin whale	0.0047	July	0.0013	May
NARW	0.0037	May	0.0022	May
Sei whale	0.0019	May	0.0007	May
Sperm whale	0.0017	August	0.0003	August

ECC = export cable corridor; km = kilometers; km^2 = square kilometers; mi = miles
Source: Summarized from Tables 42 and 43 MMPA ITA (LGL 2024)

To calculate the potential exposure from UXO detonations in the Lease Area and ECC, the maximum areas to Level A and Level B thresholds from a single detonation in the Lease Area and the ECC summarized in Table 5.2-21 were then multiplied by three (for Year 1) and two (for Year 2) and then multiplied by the estimated marine mammal densities (Table 5.2-23). The division of 5 total detonations across the two years was based on the relative number of foundations to be installed in each year. Based on the calculations, the largest potential Level A exposure from UXO detonations with 10-decibel attenuation is two NARW and two fin whales and the largest potential Level B exposure is 21 fin whales (Table 5.2-23).

Table 5.2-23. Estimated Level A and Level B exposures (# of individuals) from potential UXO detonations for construction years 1 and 2 assuming 10 dB of attenuation.

Species	Estimated Level A and Level B exposures (# of individuals) from UXO detonations													
	Density- based Estimates Year 1				Density-based Estimates Year 2				PSO Data-based Estimate	Mean Group Size	Year 1 Exposures		Year 2 Exposures	
	Level A		Level B		Level A		Level B							
	ECC	LA	ECC	LA	ECC	LA	ECC	LA			Level A	Level B	Level A	Level B
Blue whale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	1.0	1	1	1	1
Fin whale	0.3	0.8	6.2	6.3	0.2	0.5	4.1	4.2	0.5	1.8	2	13	1	9
NARW	0.5	0.6	4.9	5.0	0.3	0.4	3.3	3.3	-	2.4	2	10	1	7
Sei whale	0.2	0.3	2.5	2.6	0.1	0.2	1.7	1.7	-	1.6	1	6	1	4
Sperm whale	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	2.0	1	2	1	2

dB = decibel ; ECC = export cable corridor ; LA = Lease Area ; PSO = protected species observer ; UXO = unexploded ordnance
*Density-based estimates, PSO-based estimates, and Mean Group size values are round off to the nearest tenth
Source : Table 50 MMPA ITA (LGL 2024)

Should UXOs be encountered in the Project area, non-explosive methods will first be employed to lift and move these UXOs. Only after these alternatives are considered would a decision to detonate the UXO in place be made and no more than a single UXO will be detonated in a 24-hour period. Decisions on removal methods will be made in consultation with a UXO specialist and in coordination with the agencies with regulatory oversite of UXO. For detonations that cannot be avoided due to safety considerations, a range of mitigation and monitoring measures will be implemented to reduce the potential for auditory and non-auditory injuries (Section 3.3, Table 3.3-1). These measures include active visual and acoustic monitoring by PSOs to establish UXO detonation clearance zones as summarized in Table 3.3-1. The pre-start clearance zone size will be dependent on the charge weight of the identified UXO, which will be determined prior to detonation. If the charge weight is determined to be unknown or uncertain, the largest pre-start clearance zone size (charge weight bin E12) will be used throughout the pre-start clearance period.

A 60-minute pre-start clearance zone will be established prior to detonation. A PAM operator will begin acoustic monitoring 60 minutes prior to detonation. The pre-start clearance zone must be fully visible for 60 minutes and all marine mammals must be confirmed to be out of the pre-start clearance zone for at least 30 minutes before detonation may commence. Sound source verification will allow for adaptive monitoring and the adjustment of clearance zones as needed based on reported measurements (Table 3.3-1 and Table 3.3-2, BA-19 and BA-20). Post detonation monitoring will occur for 30 minutes. Only one detonation would occur in a 24-hour period and planned UXO detonations will not be conducted during nighttime hours. Further, as an additional measure to minimize impacts to NARWs, planned detonations are prohibited between January and April where NARW density is at its highest.

A noise attenuation system (NAS) similar to those described for monopile foundation installations is planned to be used during any UXO detonations. The use of a NAS is expected to achieve at least the same 10 decibels of attenuation assumed for foundation installation. This is based on an assessment of UXO-clearance activity in European waters summarized by Bellmann and Betke (2021) and has been assumed in the estimated distances to thresholds as summarized in Table 5.2-20 and Table 5.2-21.

The injury zones surrounding explosives detonations are of key importance for developing mitigation designed to minimize takes. As reported in Table 5.2-20, the ranges for mortality, lung, and gastrointestinal injury are short distances; the greatest distance is 794 feet (242 meters). As the pre-clearance zones are considerably larger than this distance and were calculated by selecting the largest Level A threshold (the larger of either the PK or SEL noise metric), the potential for these injuries would be greatly reduced. Along with the low number of potential UXOs (conservatively up to five in the Lease Area and five in the ECCs) identified in the Project area and SouthCoast Wind's commitment to implement extensive mitigation and monitoring measures, potential Level A harassment associated with UXO detonations would be considered extremely unlikely to occur and thus **discountable**. As the behavioral zones are larger than the PTS zones, behavioral disturbance (Level B) could potentially occur. However, Level B harassment would also be greatly reduced by the mitigation measures outlined above and would only occur at the level of the individual animal and are not expected to have population-level effects. Individual effects would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Therefore, adverse effects of UXO detonation leading to Level A and Level B harassment **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.2.6.2 Sea Turtle

UXO detonations could generate high pressure levels that could cause disturbance and injury to sea turtles. The Falmouth ECC does not overlap any UXO areas or Formerly Used Defense Sites (USACE 2019; AECOM 2020). The Brayton Point ECC intersects one land-based FUDS that is listed as closed out and complete but extends out into the Sakonnet River (USACE 2019). During BOEM's pre-screening process for the selection of the Massachusetts/Rhode Island Wind Energy Areas, the nearest UXO site was found 10 miles (16 kilometers) west of the Massachusetts/Rhode Island Wind Energy Area (BOEM 2013). A desktop study by SouthCoast Wind of UXO in the Project area concluded that there is a varying Low to Moderate risk from encountering UXO on site. The risk is Moderate throughout all of the Lease Area, and a relatively equal ratio between Low and Moderate within the ECCs (Appendix E7, SouthCoast Wind 2023).

If an animal is exposed to an explosive blast underwater, the likelihood of injury depends on the charge size, the geometry of the exposure (distance to the charge, depth of the animal and the charge), and the size of the animal. In general, an animal would be less susceptible to injury near the water surface because the pressure wave reflected from the water surface would interfere with the direct path pressure wave, reducing positive pressure exposure. However, rapid under-pressure phase caused by the negative surface-reflected pressure wave above an underwater detonation may create a zone of cavitation that may contribute to potential injury. In general, blast injury susceptibility would increase with depth, until normal lung collapse (due to increasing hydrostatic pressure) and increasing ambient pressures again reduce susceptibility.

Primary blast injury is injury that results from the compression of a body exposed to a blast wave. This is usually observed as barotrauma of gas-containing structures (e.g., lung and gut) and structural damage to the auditory system (Greaves et al., 1943; OSG, 1991; Richmond et al., 1973. The lungs are typically the first site to show any damage, while the solid organs (e.g., liver, spleen, and kidney) are more resistant to blast injury (Clark & Ward, 1943). Recoverable injuries would include slight lung injury, such as capillary interstitial bleeding, and contusions to the gastrointestinal tract. More severe injuries would significantly reduce fitness and likely cause death in the wild. Rupture of the lung may also introduce air into the vascular system, producing air emboli that can cause a stroke or heart attack by restricting oxygen delivery to critical organs. In this discussion, primary blast injury to auditory tissues is considered gross structural tissue injury distinct from noise-induced hearing loss.

Data on observed injuries to sea turtles from explosives is generally limited to animals found following explosive removal of offshore structures (Viada et al., 2008), which can attract sea turtles for feeding opportunities or shelter. Klima et al. (1988) observed a turtle mortality subsequent to an oil platform removal blast, although sufficient information was not available to determine the animal’s exposure. Klima et al. (1988) also placed small sea turtles (less than 7 kilograms) at varying distances from piling detonations. Some of the turtles were immediately knocked unconscious or exhibited vasodilation over the following weeks, but others at the same exposure distance exhibited no effects. Incidental impacts on sea turtles were documented for exposure to a single 1200-lb (540 kilograms) underwater charge off Panama City, FL in 1981. The charge was detonated at mid-depth in water 120 feet (37 meters) deep. Although details are limited, the following were recorded: at a distance of 500-700 feet (150-200 meters), a 400 pounds (180 kilograms) sea turtle was killed; at 1,200 feet (370 meters), a 200-300 pounds (90-140 kilograms) sea turtle experienced “minor” injury; and at 2,000 feet (600 meters) a 200-300 pounds (90-140 kilograms) sea turtle was not injured (O’Keeffe & Young, 1984).

Acoustic modeling has been conducted for SouthCoast Wind Project scenarios (Hannay and Zykov 2022). Maximum exceedance distance to TTS and PTS for the largest class of UXO with no mitigation in place were modeled to be 3,839 feet (1,170 meters) and 2,011 feet (613 meters) respectively (Table 5.2-24). Accounting for 10-decibel mitigation, maximum exceedance distances for TTS and PTS for the largest class of UXO were modeled to be 1,309 feet (399 meters) and 692 feet (211 meters) respectively. The range to exceedance of Level-A and Level-B exposures were modeled at depths of 33-98 feet (10-30 meters) to approximate the ECC and 148-197 feet (45-60 meters) to approximate the Lease Area (Table 5.2-25). Range to Level A threshold exceedance was found to be 0.4 miles (0.6 kilometers) in the ECC and 0.2 miles (0.3 kilometers) in the Lease Area for the largest UXO charge size. Range to Level B threshold exceedance was found to be 6,988 feet (2,130 meters) in the ECC and 7,382 feet (2,250 meters) in the Lease Area under the largest UXO charge size. These model results assume 10 decibels of noise attenuation. Ranges for the onset of mortality, non-auditory lung injury, and gastrointestinal injury in adult sea turtles were also modeled (Table 5.2-26). Under the largest UXO classification, mortality was found to occur at a range of 689 feet (210 meters) in the ECC and 735 feet (224 meters) in the Lease Area. Onset of non-auditory lung injury was found to occur at a range of 1,309 feet (399 meters) in the ECC and 1,483 feet (452 meters) in the Lease Area. The onset of gastrointestinal injury was found to occur at a range of 410 feet (125 meters).

Table 5.2-24. Sea turtles PTS and TTS maximum exceedance distances (meters) to TTS and PTS thresholds for peak pressure (L_{pk}) for various UXO charge sizes

Mitigation	TTS / PTS L_{pk} threshold (dB re 1 µPa)	E4 (2.3 kg)		E6 (9.1 kg)		E8 (45.5 kg)		E10 (227 kg)		E12 (454 kg)	
		TTS	PTS	TTS	PTS	TTS	PTS	TTS	PTS	TTS	PTS
Unmitigated	226 / 232	201	105	318	166	543	285	929	487	1170	613
10 dB Mitigation	226 / 232	69	36	108	57	185	98	317	168	399	211

dB = decibel; kg = kilogram; PTS = permanent threshold shift; TTS = temporary threshold shift; UXO = unexploded ordnance
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
Source: Table 10 and Table 33 (Hannay and Zykov 2022).

Table 5.2-25. Range (meters) to SEL PTS-onset and SEL TTS-onset exposure thresholds in the ECC and Lease Area for sea turtles for 5 UXO charge sizes assuming 10 dB of noise attenuation, and the maximum area exposed above this threshold.

Range per UXO Charge Size	ECC		Lease Area	
	PTS	TTS	PTS	TTS
E4 R95% Distance (m)	<50	134	<50	203
E6 R95% Distance (m)	72	358	<50	448
E8 R95% Distance (m)	190	796	63	870
E10 R95% Distance (m)	424	1610	201	1780
E12 R95% Distance (m)	555	2130	300	2250

dB = decibel; ECC = export cable corridor; m = meter; PTS = permanent threshold shift; TTS = temporary threshold shift; UXO = unexploded ordnance
SEL = frequency weight sound exposure level in decibels referenced to 1 microPascal squared second; also written L_E

Table 5.2-26. Ranges (meters) to the onset of mortality, non-auditory lung injury, and gastrointestinal (GI) injury thresholds in the Lease Area and ECCs for five UXO size classes assuming 10 dB of noise attenuation for sea turtles. GI injury combines ECC and Lease Area. Thresholds are based on animal mass and submersion depth.

Range per UXO Charge Size	Mortality				Non-Auditory Lung Injury				GI Injury
	ECC		Lease Area		ECC		Lease Area		L_{pk} threshold 237 dB re 1 uPA
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	
E4 R95% Distance (m)	14	6	11	5	35	16	26	13	21
E6 R95% Distance (m)	39	18	26	14	88	43	83	34	34
E8 R95% Distance (m)	108	56	106	44	223	126	236	126	58
E10 R95% Distance (m)	233	151	253	155	441	298	497	326	99
E12 R95% Distance (m)	308	210	345	228	557	399	639	452	125

dB= decibel; ECC = export cable corridor; GI = gastrointestinal; m = meters; UXO = unexploded ordnance
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
Source: Summarized from Tables 34 – 44 (Hannay and Zykov 2022).

UXO detonations would only occur from May through November. While this coincides with the highest densities of leatherback and loggerhead sea turtles, the potential for serious injury is minimized by the implementation of a range of mitigation and monitoring measures that include establishing pre-clearance and shutdown zones that would facilitate a delay in detonations if sea turtles were observed approaching or within areas that could be ensonified above sound levels that could result in auditory and non-auditory injury (Section 3.3, Table 3.3-2, BA-38). Pre-start clearance zones, commensurate with marine mammal hearing group and UXO charge weight, range from 1,312 to 28,543 feet (400 to 8,700 meters), which includes a 7,382-foot (2,250-meter) sea turtle clearance zone. Sixty minutes prior to detonation, this zone will be monitored visually by at least two PSO vessels (with two PSOs on watch) and acoustically with the use of a PAM system. The PAM system will have the capability of monitoring up to 15 kilometers from the detonation location. These ranges cover observed PTS/TTS ranges for sea turtles: <656 feet (<200 meters) lethal, 1,214 feet (370 meters) minor injury, and 1,969 feet (600 meters) no injury (U.S. Navy 2017a citing O'Keeffe and Young 1984). Any sightings of a sea turtle would cause the clock to restart, after the animal has moved out of the monitoring zone. Only one detonation would occur in a 24-hour period and no planned detonation will occur during nighttime hours. These measures make it unlikely that any sea turtles will be exposed to UXO detonations that would result in mortality and slight lung injury as well as severe hearing impairment or serious injury and—if exposed—would more likely have the potential to result in slight PTS (i.e., minor degradation of hearing capabilities at some hearing thresholds). The potential for PTS/non-auditory injury is further minimized by the use of a NAS during all UXO detonations. The proposed requirement that UXO detonations can only commence when the pre-clearance zones are fully visible to PSOs allows the potential for high sea turtle detection capability and enables a high rate of success in the implementation of these zones to avoid serious injury. Given the low densities of sea turtles within 3 miles (5 kilometers) of the SouthCoast Lease Area (< 1 turtle per 100 square kilometers in and near the Lease Area for all species in any season) and the strict implementation of mitigation measures, the potential for PTS or TTS exposure to these sea turtle species is considered extremely unlikely to occur and is **discountable**.

Studies of the reactions of sea turtles to explosives are limited in the literature. Finneran et al. (2017) assumed that sea turtles are likely to exhibit no more than a brief startle response to any individual explosive. Avoidance of the area is only considered likely if the event includes multiple explosives events. Popper et al. (2014) suggest that in response to explosions, sea turtles have a high risk for behavioral disturbance in the near and intermediate fields (e.g., tens of meters and hundreds of meters respectively), and low risk in the far field (thousands of meters). The risk for TTS and other recoverable injuries were considered high in near and intermediate fields, and low in the far field (Popper et al. 2014). Klima et al. (1988) studied sea turtle reactions to the removal of oil platforms in the Gulf of Mexico using explosives and to the use of explosives in the area by the U.S. Navy. Results indicated a possible positive correlation with explosive use and sea turtle stranding on nearby beaches.

Should an exposure occur, the potential effects would be brief (e.g., a single noise exposure and the sea turtle would react to it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Thus, given the low densities of sea turtles in the Project Area, the proposed avoidance and minimization measures, and the low number of potential detonations required for the Proposed Action (modeled for no more than 10), the effects of noise exposure from Project UXO detonations leading to PTS/mortality/slight lung injury/gastrointestinal injury **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.2.6.3 Fish

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. Effects of detonation pressure exposures to fish have been assessed according to the SPL limits for onset of mortality or injury leading to mortality due to explosives, as recommended by the American National Standards Institute (ANSI) expert working group (FHWG 2008, Popper et al. 2014) and provided in Table 5.2-27. The onset of mortality and physical injury thresholds for underwater explosives are the same for all fish species groups (NMFS2023r). The present assessment has applied the lower range value for the onset of mortality at SPL = 229 dB re 1 µPa. Acoustic modeling of UXO detonations by SouthCoast Wind estimated the exceedance distances for the onset of mortality for fish with and without swim bladder for various UXO charge sizes (Table 5.2-28). Under the largest UXO category, injury was modeled to occur at a range of 2,779 feet (847 meters) with no mitigation in place, however, with 10 dB noise attenuation, exceedance distance was reduced to 951 feet (290 meters).

Table 5.2-27. Effects of detonation pressure exposures

Type of Animal	Onset of Mortality	Onset of Physical Injury	Recoverable injury	TTS	Masking	Behavior
Fish: where swim bladder is not involved in hearing (particle motion detection	229 -234 dB (L_{PK})	206 dB (L_{PK}) 187 dB (L_E)	Near field: High	Near field: High	N/A	Near field: High
			Intermediate field: High	Intermediate field: Moderate		Intermediate field: High
			Far field: Low	Far field: Low		Far field: Low

dB = decibel; TTS = temporary threshold shift, N/A = not applicable
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = frequency weight sound exposure level in decibels referenced to 1 microPascal squared second; also written as SEL
Source: Table 9 (Hannay and Zykov, 2022); NMFS 2023r

Table 5.2-28. Exceedance distances (m) for Onset of mortality for fish with and without a swim bladder due to peak pressure exposures, for various UXO charge sizes

Mitigation	Onset of Mortality L_{pk} (dB re 1 μPa)	E4 (2.3 kg)	E6 (9.1 kg)	E8 (45.5 kg)	E10 (227 kg)	E12 (454 kg)
Unmitigated	229	145	230	393	671	847
10 dB Mitigation	229	49	80	135	230	290

dB = decibel; kg = kilogram; m = meter; UXO = unexploded ordnance
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
Source: Summarized from Table 22 and Table 45 (Hannay and Zykov, 2022).

Reaction of fish to explosives is largely absent from literature. Finneran et al. (2017) assume that sea turtles are likely to exhibit no more than a brief startle response to any individual explosive, which is likely similar to fish. Avoidance of the area is only considered likely if the event includes multiple explosives events, which is not part of the Proposed Action. Popper et al. (2014) suggest that in response to explosions, Atlantic sturgeon have a high risk for behavioral disturbance in the near and intermediate fields (e.g., tens of meters and hundreds of meters respectively), and low risk in the far field (thousands of meters). The risk for TTS was considered high in near, moderate in the intermediate fields, and low in the far field. Recoverable injuries were considered high in near and intermediate fields, and low in the far field (Popper et al. 2014; Table 5.2-27).

The Project area has variable rates of Atlantic sturgeon bycatch with most bycatch near the northern portion of the Brayton Point ECC, and no bycatch recorded in the Falmouth ECC or Lease Area from 1989 to 2000 (Stein et al. 2004). This suggests that most of the Project area has a low abundance of Atlantic sturgeon, further supported by the fact that one of the most impacted fisheries (Otter trawl targeting longfin squid) (NMFS 2023g) is one of the main gear types that fishes in the Project area and is one of the main gears associated with the bycatch of Atlantic sturgeon (Stein et al. 2004). This further bolsters the idea that Atlantic sturgeon are not prevalent in the Project area. Further, most of the area where bycatch rates are high for Atlantic sturgeon have a low risk of encountering a UXO (Figure 3.1-16)

Given the dispersed distribution of Atlantic sturgeon in the Project area, the potential for co-occurrence in time and space is considered unlikely but possible. SouthCoast Wind is not planning to monitor for Atlantic sturgeon prior to detonations but has committed to the implementation of NAS during all detonation events. The use of NAS is expected to provide 10 decibels of noise mitigation and would reduce the exceedance distance for the onset of injury to 751 feet (229 meters) for the largest UXO detonations. This, coupled with the unlikely detonation of UXO, the low number of potential detonations required for the Proposed Action (modeled for no more than 10), further reduces the potential for exposure to Atlantic sturgeon, thus, such effects are considered to be **discountable**. Therefore, the effects of noise exposure from Project UXO detonations leading to injury or behavioral disturbance **may affect, not likely to adversely affect** Atlantic sturgeon.

5.2.7 Summary of Underwater Noise Effects

5.2.7.1 Marine Mammals

Noise associated with G&G surveys, dredging, and cable laying for the Proposed Action are not expected to result in injury of ESA-listed marine mammals based on the source levels or small ranges to injury thresholds. Therefore, the risk of injury associated with these noise sources is discountable. Vibratory pile driving is also not typically associated with physical injury or mortality, but for this Project, the effects of vibratory pile driving were modeled concurrently with impact pile driving and could not be evaluated separately. Impact pile driving and UXO detonation have the potential to cause injury in ESA-listed marine mammals; however, the mitigation measures described in Section 3.3 and summarized in this section are expected to minimize the risk of injury for ESA-listed marine mammals. Impact pile driving, vibratory pile driving, G&G surveys, cable laying, and UXO detonations could all result in behavioral effects on ESA-listed marine mammals. These effects would be temporary but could occur over relatively large distances for some noise sources.

5.2.7.2 Sea Turtles

Noise associated with G&G surveys, dredging, and cable laying for the Proposed Action are not expected to result in injury of ESA-listed sea turtles based on the source levels or small ranges to injury thresholds. Therefore, the risk of injury associated with these noise sources is discountable. Impact pile driving and UXO detonation have the potential to cause injury in ESA-listed sea turtles; however, the mitigation measures described in Section 3.3 and summarized in this section, specifically the use of noise mitigation systems or techniques that achieve a 10-decibel reduction in sound levels and the strict implementation of clearance zones would make the risk of sea turtle injury associated with UXO detonation and impact and concurrent vibratory pile driving discountable. Impact pile driving, vibratory pile driving, G&G surveys, cable laying, and UXO detonations could all result in behavioral effects on ESA-listed sea turtles. These effects would be temporary but could occur beyond a localized area for impact pile driving.

5.2.7.3 Fish

Noise associated with G&G surveys, dredging, and cable laying for the Proposed Action are not expected to result in injury of ESA-listed fish species based on the source levels or small ranges to injury thresholds. Therefore, the risk of injury associated with these noise sources is discountable. Impact pile driving and UXO detonations have the potential to cause injury in ESA-listed fish species; however, the mitigation measures described in Section 3.3 and summarized in this section (e.g., soft start procedures, clearance zones, NAS) are expected to minimize injury risk associated with UXO detonation and impact and concurrent vibratory pile driving for this species. Impact pile driving, vibratory pile driving, G&G surveys, cable laying, and UXO detonations could all result in behavioral effects on ESA-listed fish species. These effects would be temporary but could occur over relatively large distances during impact pile driving.

5.3 Other Noise Impacts

In addition to the activities evaluated in Section 5.2, the Proposed Action includes other noise sources that have the potential to affect aquatic species during construction, O&M, and decommissioning. These additional noise sources would include vessels (Section 5.3.1), helicopters and drones (Section 5.3.2), and WTGs (Section 5.3.3). Following the assessment of these noise sources, a summary of overall noise effects to ESA-listed species is provided (Section 5.3.4).

5.3.1 Vessels

The Proposed Action includes the use of vessels during construction, O&M, and decommissioning, as described in Section 3.1.2.6. Vessels generate low-frequency (10 to 100 hertz) (MMS 2007), continuous noise that could affect aquatic species. There are several types of vessels that would be required throughout the life of the Project. Table 3.1-15 and Table 3.1-16 outline the type of vessels that would be required for Project construction and operations as well as the maximum number of vessels required by vessel type. The size of these vessels ranges from 325 to 350 feet (99 to 107 meters) in length, from 60 to 100 feet (18 to 30 meters) in beam, and draft from 16 to 20 feet (5 to 6 meters). Source levels for large vessels range from 177 to 188 dB re 1 μPa SPL_{rms} with frequencies between less than 40 hertz and 100 hertz (McKenna et al. 2012). Smaller support vessels typically produce higher-frequency sound concentrated in the 1,000 hertz to 5,000 hertz range, with source levels ranging from 150 to 180 dB re 1 μPa SPL_{rms} (Kipple 2002; Kipple and Gabriele 2003).

5.3.1.1 Marine Mammals

A comprehensive review of the literature indicates no direct evidence of hearing impairment (either PTS or TTS) occurring in marine mammals as a consequence of exposure to vessel-generated sound. Since PTS exposures are not expected for any of the ESA-listed marine mammal species during Project vessel activities, injury or mortality from vessel noise is unlikely and noise exceeding PTS thresholds will have **no effect**.

Vessel noise overlaps with the hearing range of marine mammals and may cause behavioral responses, stress responses, and masking of their communication space (Erbe et al. 2018, 2019; Nowacek et al. 2007; Southall et al. 2007; Richardson et al. 1995). Observed behavioral responses include startle responses, changes in dive patterns or swim velocities, and avoidance. These responses have been shown to vary by gender and by individual, and in certain cases, have been correlated with numbers of vessels and their proximity, speed, and directional changes. In addition to behavioral responses, physiological or stress responses like changes in respiration rates can occur. In NARW, vessel noise is known to increase stress hormone levels, which may contribute to suppressed immunity and reduced reproductive rates and fecundity (Hatch et al. 2012; Rolland et al. 2012).

Acoustic responses to vessel sound include alteration of the composition of call types, rate and duration of call production, and actual acoustic structure of the calls. Based on the low frequencies produced by vessel noise and the relatively large propagation distances associated with low-frequency sound, LFC, including fin whales and NARWs, are at the greatest risk of impacts associated with vessel noise. Masking may interfere with detection of prey and predators and reduce communication distances. Modeling results indicate that vessel noise has the potential to substantially reduce communication distances for NARWs (Hatch et al. 2012).

Vessel activity associated with the Proposed Action is expected to cause repeated, intermittent impacts on ESA-listed marine mammals resulting from short-term, localized behavioral responses to vessel noise. These responses would dissipate once the vessel or an individual leaves the area and are expected to be infrequent given the patchy distribution of marine mammals in the Action Area. Any behavioral effects in response to vessel noise are not expected to be biologically significant (U.S. Navy 2018). Mitigation and monitoring measures that will be implemented to reduce vessel interactions would also help reduce potential vessel noise exposure to ESA-listed marine mammals (Section 3.3, Table 3.3-1, Table 3.3-2). These measures include active visual and acoustic monitoring (Table 3.3-1 and Table 3.3-2, BA-4 to 5), establishing vessel separation distances, and vessel speed reduction (Table 3.3-1 and Table 3.3-2, BA-7 to 9).

Based on these mitigation measures, and the fact that behavioral effects would not be biologically significant for individual marine mammals, exposure to vessel noise would not be expected to have population-level effects. As discussed above, NARW, fin whales, and sei whales may be exposed to noise above the behavioral thresholds and masking effects depending on the type and speed of the vessel. However, given the interim definition for ESA harassment, the animal's ability to avoid harmful noises, and the established mitigation and monitoring measures being proposed, the exposure of ESA-listed marine mammals to vessel noise that results in behavioral disturbance or masking would not rise to the level of take under the ESA and is, therefore, **insignificant**. Noise exposure from Project vessel operations leading to injury or behavioral disturbance **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.3.1.2 Sea Turtles

It is unlikely that received levels of underwater noise from vessel activities would exceed PTS thresholds for sea turtles; therefore, injury or mortality from vessel noise is unlikely and noise exceeding PTS thresholds will have **no effect**.

Vessel noise overlaps with the hearing range of sea turtles and may elicit behavioral responses, including startle responses and changes in diving patterns, or a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). There is very little information regarding the behavioral responses of sea turtles to underwater noise. A recent study suggests that sea turtles may exhibit TTS effects even before they show any behavioral response (Woods Hole Oceanographic Institution 2022). Hazel et al. (2007) demonstrated that sea turtles appear to respond to vessels with avoidance behavior at close range (approximately 10 meters or closer). Based on the source levels outlined above, the behavioral threshold for sea turtles is likely to be exceeded by Project vessel noise. Popper et al. (2014) suggests that in response to continuous shipping sounds, sea turtles have a high risk for behavioral disturbance in the near field (e.g., tens of meters), moderate risk in the intermediate field (hundreds of meters), and low risk in the far field (thousands of meters).

Vessel noise associated with the Proposed Action could cause repeated, intermittent impacts on sea turtles resulting from short-term, localized behavioral responses. Behavioral effects are considered possible but would be temporary with effects dissipating once the vessel or individual has left the area. The implementation of mitigation and monitoring measures to reduce vessel interactions as outlined in Section 3, Table 3.3-2, would also reduce potential vessel noise exposure to ESA-listed sea turtles. These measures include vessel speed reductions to 4 knots when a sea turtle is sighted within 328 feet (100 meters) of the forward path and avoiding transiting through areas of visible jellyfish aggregations or floating *Sargassum* (BA-10), visual monitoring, and establishing vessel separation distances (BA-5 to 7). Based on these measures, sea turtles are expected to have a low probability of exposure to underwater noises above behavioral thresholds from vessel operations. Should an exposure occur, the potential effects would be brief (e.g., a sea turtle may approach the noisy area and divert away from it), and any effects of this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Therefore, the effects of noise exposure from Project vessel operations leading to injury or behavioral disturbance **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.3.1.3 Fish

It is unlikely that received levels of underwater noise from vessel activities would exceed physiological injury thresholds for Atlantic sturgeon; therefore, the potential for ESA-listed Atlantic sturgeon to be exposed to noise above physiological injury thresholds is considered extremely unlikely to occur and is **discountable**.

Vessel noise may result in brief periods of exposure near the surface of the water column but is not expected to cause injury, hearing impairment, or long-term masking of biologically relevant cues in fish. Behavioral responses of fish to vessel noise are variable but include avoidance or scattering of schooling fishes (Misund and Aglen 1992). Impacts from vessel noise are expected to be temporary and localized. Adverse impacts on fish from noise generated by vessel transit and operations are unlikely (BOEM 2018).

Potential masking effects to fish from vessel noise has been reported (Vasconcelos et al. 2007), as well as behavioral effects from similar sources. Continuous sounds produced by marine vessels have been reported to change fish behavior, causing fish to change speed, direction, or depth; induce avoidance of impacted areas by fish; or alter fish schooling behavior (Engås et al. 1995, 1998; Sarà et al. 2007; De Robertis and Handegard 2013; Mitson and Knudsen 2003). It was observed that high levels of low-frequency noise (from 10 to 1,000 hertz) may be responsible for inducing an avoidance reaction (Sand et al. 2008). Popper et al. (2014) suggests that in response to continuous sounds, Atlantic sturgeon have a moderate risk for behavioral disturbance in the near field (e.g., tens of meters) and intermediate field (hundreds of meters) and low risk in the far field (thousands of meters). Masking effects are considered high risk in the near and intermediate field and moderate in the far field and TTS effects are considered of moderate risk in the near field and low in the intermediate and far fields.

Behavioral effects are considered possible but would be temporary with effects dissipating once the vessel or individual has left the area. In addition, Atlantic sturgeon are benthic feeders and therefore, are unlikely to be affected while foraging by a transient vessel noise source. Should an exposure occur, the potential effects would be brief (e.g., Atlantic sturgeon may approach the vessel and divert away from it), and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore **insignificant**. Further, the implementation of mitigation and monitoring measures to reduce vessel interactions as outlined in Section 3, Table 3.3-2 (BA-5 to 7), would also reduce potential vessel noise exposure to ESA-listed Atlantic sturgeon. Therefore, the effects of noise exposure from Project vessel operations leading to injury or behavioral disturbance **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.3.2 Helicopters and Drones

Helicopter support would be required during several Project activities through construction, O&M, and decommissioning. The number of helicopter trips required for construction is provided in Table 3.1-15. Though helicopters produce in-air noise, a small portion of the produced sound can be transmitted through the water surface and propagate in the aquatic environment. Underwater sound produced by helicopters is generally low frequency (less than 500 hertz) and continuous with sound levels at or below 160 decibels referenced to 1 micropascal (Richardson et al. 1995). Kuehne et al. (2020) demonstrated that large Boeing EA-18G Growler aircrafts produced underwater noise levels of 134 (± 3) dB re 1 µPa SPL_{rms} measured at a depth of 30 m. Noise levels from helicopters required for the Project are expected to be lower than those generated by much larger aircrafts but could still elicit behavioral responses in aquatic species. The drones that would be used to support construction and O&M of the Proposed Action are a fraction of the size of and much quieter than helicopters, and as such, would fall well within the noise analysis described below for helicopters. Therefore, drones will be dismissed from further discussion.

5.3.2.1 Marine Mammals

In general, marine mammal behavioral responses to aircraft most commonly occur at distances of less than 1,000 feet (305 meters) (Patenaude et al. 2002). BOEM would require all aircraft operations to comply with current approach regulations for NARWs or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 feet (457 meters). This BA anticipates that most aircraft operations would occur above this altitude except under specific circumstances (e.g., helicopter landings on the service operations vessel or visual inspections of WTGs). Aircraft operations could result in temporary, minor behavioral responses, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). When traveling at relatively low altitude, helicopter noise that propagates underwater has the potential to elicit short-term behavioral responses in marine mammals, including altered dive patterns, percussive behaviors (i.e., breaching or tail slapping), and disturbance at haul-out sites (Efroymson et al. 2000; Patenaude et al. 2002). Helicopters transiting to and from the Action Area are expected to fly at sufficiently high altitudes to avoid behavioral effects on marine mammals, with the exception of WTG inspections, take-off, and landing. Additionally, Project aircraft would comply with current approach regulations for NARWs. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leaves the area, and are not expected to be biologically significant.

Based on the analysis above, any exposure to aircraft noise above PTS, TTS, and behavioral thresholds for all ESA-listed marine mammal species is considered extremely unlikely to occur and **discountable**. Therefore, noise exposure from Project aircraft activities leading to PTS/TTS/behavioral disturbance or masking **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.3.2.2 Sea Turtles

Patenaude et al. (2002) showed that aircraft operations could result in temporary behavioral responses to marine mammals, however, similar studies on sea turtles are not available in the literature. When traveling at relatively low altitude, helicopter noise could elicit stress or behavioral responses in sea turtles (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Popper et al. (2014) suggest that in response to continuous sounds (e.g., aircraft operations), sea turtles have a high risk for behavioral disturbance in the near field (e.g., tens of meters), moderate risk in the intermediate field (hundreds of meters) and low risk in the far field (thousands of meters). The potential risk for injury and TTS is considered low at all distances (Popper et al. 2014). BOEM expects that most aircraft operations would occur above 1,500 feet (457 meters; NARW aircraft approach regulation) except under specific circumstances (e.g., helicopter landings on the service operation vessel or visual inspections of WTGs); thus, aircraft noise represents an intermediate risk for behavioral disturbance. However, any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area. These temporary behavioral responses are not expected to be biologically significant.

Based on the analysis above, exposure to Project aircraft noise above PTS, TTS, and behavioral thresholds for all ESA-listed sea turtles is extremely unlikely to occur and is **discountable**. Therefore, the effects of noise exposure from Project aircraft activities leading to PTS/TTS/behavioral disturbance **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.3.2.3 Fish

Noise from helicopters may cause behavioral changes in fish in the immediate vicinity of the noise source. Near-surface pelagic fish may detect helicopter noise that has transmitted through the water surface, but noise levels from aircraft would be greatly diminished when they reach benthic/demersal habitats and may be at least partially masked by ambient ocean noise. Helicopters transiting to and from the Action Area are expected to fly at sufficient altitudes to avoid behavioral effects on fish, with the exception of WTG inspections, take-off, and landing. Any behavioral responses that occur during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant. However, as Atlantic sturgeon are demersal, they are unlikely to experience behavioral effects of helicopter noise.

Based on the analysis above, exposure of noises above physiological injury, TTS, and behavioral thresholds from Project aircraft for Atlantic sturgeon is extremely unlikely to occur and is **discountable**. Therefore, the effects of noise exposure from Project aircraft activities leading to physiological injury/TTS/behavioral disturbance **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.3.3 Wind Turbine Generators

WTGs operating during the O&M phase of the Proposed Action would generate non-impulsive but continuous sound in the offshore environment. Reported sound levels of operational wind turbines smaller than 6 MW is generally low (Madsen et al. 2006; Tougaard et al. 2020; Stöber and Thomsen 2021) with a source SPL of about 151 dB re 1 µPa m and a frequency range of 60 to 300 hertz (Wahlberg and Westerberg 2005; Tougaard et al. 2020). While the underwater noise levels produced by WTGs are expected to exceed ambient underwater noise levels at frequencies below 500 hertz (Tougaard et al. 2009a), it dissipates to ambient levels within 0.6 miles (1 kilometers) in low ambient noise areas (Dow Piniak et al. 2012; Elliott et al. 2019; summarized in Tougaard et al. 2020). For instance, at Block Island Wind Farm, turbine noise reached ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Measurements from the Coastal Virginia Offshore Wind-Pilot Project indicated that SPL would range from approximately 110 to 125 dB re 1 µPa based on measured data normalized to a distance of 100 meters from the source and a wind speed of 10 m/s (HDR 2023).

Various studies have documented sound pressure levels at various distances from operating turbines, with variations depending on factors like wind speed and turbine type. For instance, Tougaard et al. 2009 measured SPLs ranging between 109 and 127 dB re 1 µPa underwater at 46 and 66 feet (14 and 20 meters) from the foundations at frequencies below 315 hertz up to 500 hertz. Wind turbine acoustic signals above ambient background noise were detected up to 2,066.9 feet (630 meters) from the source (Tougaard et al. 2009). Noise levels were shown to increase with higher wind speeds (Tougaard et al. 2009). Another study detected SPLs of 125 to 130 dB re 1 µPa up to 984 feet (300 meters) from operating turbines in frequencies between 875 and 1,500 hertz (Lindeboom et al. 2011). At 164 feet (50 meters) from a 3.6-megawatt (MW) monopile wind turbine, Pangerc et al. (2016) recorded maximum SPLs of 126 dB re 1 µPa with frequencies of 20 to 330 hertz, which also varied with wind speed. Kraus et al. (2016) measured ambient noise conditions at three locations adjacent to the proposed South Fork Wind Farm over a 3-year period and identified baseline levels of 102 to 110 dB re 1 µPa. They also found that maximum operational noise levels typically occurred at higher wind speeds when baseline noise levels are also higher due to wave action. Holme et al. (2023) conducted measurements from three wind farms consisting of 6.3 to 8.3 MW WTGs and reported that noise emitted by WTGs at distances exceeding 1 kilometer from the wind farm boundary had no significant impact on the broadband underwater sound levels. Variations by up to 5 dB inside and outside the wind farms were observed in the ambient recorded sound levels despite turbines being at a standstill (i.e., not moving) and under low wind conditions. This is consistent with findings reported by Bellman et al. (2023) suggesting that ambient noise levels inside and outside the wind farms can be largely influenced by other sound sources, especially in areas with significant vessel activity. Thus, when evaluating WTG noise, it is important to factor the influence of anthropogenic (e.g., vessel noise) and natural (e.g., wind and waves) sound sources in the overall cumulative impact of WTG operational noise.

Tougaard et al. (2020) summarized available monitoring data on wind farm operational noise, including older generation, geared turbine designs and a study (Elliot et al. 2019) focusing on quieter, modern, direct-drive systems. Measured underwater sound levels in the literature, as compiled by Tougaard et al. (2020), are limited to smaller geared wind turbines (less than 6.15 MW). Underwater noise generated by these smaller geared turbines is measured at a low frequency and relatively low strength near the foundation on the order of 110 to 125 dB re 1 µPa SPL at a reference distance of 164 feet, occasionally reaching as high as 128 dB re 1 µPa SPL, in the 10 Hz to 8 kHz range. For geared turbines, sound is generated by operating WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Both airfoil sound and mechanical vibration may result in long-term, continuous noise in the offshore environment; however, operational noise from WTGs has been measured at source levels that are at least 10–20 dB lower than received levels of ship noise in the same frequency range. In contrast, direct-drive systems, which do not produce the strong tonal peaks caused by gear meshing in geared turbines, measured lower SPLs of 114 to 121 dB re 1 µPa at 164 feet (50 meters) from the source for a 6 MW turbine (Elliot et al. 2019).

Based on measurements from WTGs 6 MW and smaller, Stöber and Thomsen (2021) estimated that operational noise from larger (10 MW WTG) current-generation WTGs would generate higher source levels (177 dB re 1 µPa-m) than measured from smaller turbines in earlier research. Additionally, Stöber and Thomsen (2021) estimated that a shift from gear-driven wind turbines to direct drive turbines would decrease sound levels by 10 decibels resulting in an acoustic range to the 120 dB re 1 µPa behavioral threshold of 0.9 miles (1.4 kilometers). Using the least-squares fits from Tougaard et al. (2020), SPLs from 11.5 MW turbines (in 38-knot [20 meters per second], gale-force wind) would be expected to fall below the same behavioral threshold within 804 feet (245 meters). In lighter 19-knot winds (10 meters per second), the predicted acoustic range to behavioral thresholds would be only 460 feet (140 meters). Both models were based on small turbines and a small sample size, adding uncertainty to the modeling results. A more recent study conducted standardized underwater sound measurements from 25 German offshore wind farms that included turbines up to 8.3 MW (Betke and Bellman 2023). The trend analysis in the study showed that there was no statistical increase in radiated noise with increasing turbine power size. Primary frequency ranges between 50 and 200 Hz were recorded consistently across all wind farms regardless of turbine type. The average noise levels for monopile foundations measured 121.5 dB re 1 µPa at 328 feet from the foundation. This measurement was 0.5 dB higher for other foundation types. Average noise levels for foundations with gear box drives was 122.3 dB re 1 µPa at 328 feet from the foundation; foundations with gearless (direct) drive were 2.3 dB lower (Betke and Belmann 2023). Holme et al. (2023) also found that the modeled results from Tougaard et al. (2020) tended to overestimate the sound noise by approximately 8 dB when compared to measurements taken 230 feet from the turbine. The underwater noise predictive model developed by Holmes et al. (2023) using their measurements estimated that WTG operational noise would be approximately 115 dB re 1 µPa at 230 feet (70 meters) from the turbine and approximately 117 dB re 1 µPa at 492 feet (150 meters) from the turbine. These predictions were made assuming turbines with a capacity of 6.3 MW and a wind speed velocity of 13 m/s (Holmes et al. 2023). Furthermore, Holmes et al. (2023) revealed no significant difference in noise levels between a 6.2 and 8.3 MW WTG and did not demonstrate any daily variation in their underwater sound measurements, indicating that neither power production nor wind speed had a discernible impact on the noise level produced. Considering the latest studies from Betke and Bellmann (2023) and Holmes et al. (2023), and the estimated projection that the direct-drive technology would produce lower noise levels than WTGs using gear boxes (Stöber and Thomsen 2021), a proportional rise in sound levels with increasing WTG size is not expected, and noise levels are not expected to be significantly louder than those reported from European wind farms.

5.3.3.1 Marine Mammals

WTG noise would be audible to marine mammals and therefore could affect ESA-listed marine mammal species. However, noise levels are expected to reach ambient levels within a short distance from turbine foundations (Kraus et al. 2016; Thomsen et al. 2015). Therefore, WTG noise impacts on marine mammals are expected to be too small to be meaningfully measured.

There are several studies that present sound properties of similar turbines in environments comparable to that of the Proposed Action. Field measurements during offshore wind operations have indicated that sound levels are much lower than during construction activities (Elliot et al. 2019). Additionally, Tougaard et al. (2020) summarized available monitoring data on wind farm operational noise and modeled correlations between estimated total sound pressure level and distance, wind speed, and turbine size. Their study included both older-generation, geared turbine designs and quieter, modern, direct-drive systems. Their results showed that operational noise generally attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within 0.6 mile (1 kilometer) from the source), and the combined noise level from multiple turbines is lower or comparable to that generated by a small cargo ship. More recently, Stöber and Thomsen (2021) used monitoring data and modeling to estimate operational noise from larger (10 MW), current-generation, direct-drive WTGs and concluded that these designs could generate higher operational noise levels than those reported in earlier research. Stöber and Thomsen (2021) attempted to fill this knowledge gap by extracting a strictly defined subset of the data used by Tougaard et al. (2020) to extrapolate sound levels to larger turbine sizes and to direct-drive turbines. However, the small size of their data subset greatly increased the already considerable uncertainty of the modeling results. Both studies found sounds to generally be louder for higher-powered WTGs and, thus, distances to a given sound threshold are likely to be greater for higher-powered WTGs. However, as Stöber and Thomsen (2021) point out, direct-drive technology could reduce these distances substantially.

Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the BIWF, this low-frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. 2015 and Kraus et al. 2016, SPLs would be expected to be at or below ambient levels at relatively short distances from the WTG foundations. More specifically, based on the least squares fits in Tougaard et al. 2020, SPL from a 10 MW turbine in 19-knot (10 meters per second) winds would reach 120 dB re 1 µPa at 410 feet (125 meters) from the turbine.

However, it is also probable that operational noise would change the ambient sound environment within the wind farm environment in ways that could affect habitat suitability. This impact can be evaluated by estimating the area exposed to operational noise above the existing environmental baseline. Kraus et al. (2016) measured ambient noise conditions at three locations adjacent to the proposed South Fork Wind Farm over a 3-year period and identified baseline levels of 102 to 110 dB re 1 µPa.[9] Maximum operational noise levels typically occur at higher wind speeds when baseline noise levels are higher due to wave action. Again, using equations from Tougaard et al. 2020, SPL measured from the same 10 MW turbine in the same 19-knot (10 meters per second) winds would reach 110 dB re 1 µPa at about 1,150 feet (350 meters) from the turbine.

Operational noise could interfere with communication, reducing feeding efficiency in the areas within a few hundred feet of the foundations under some conditions. Any such effects would likely be dependent on hearing sensitivity and the ability to adapt to low-intensity changes in the noise environment. For example, based on known hearing sensitivity (Johnson 1967), MFC like dolphins are likely to be less sensitive to the low-frequency sounds generated by operational WTGs. Dolphins vocalize in low to mid frequencies, suggesting the possibility of partial masking effects, but these species are also known to shift vocalization frequencies to adapt to natural and anthropogenic conditions (David 2006; Quintana-Rizzo et al.2006) and this masking would only occur very close to individual WTGs.

Overall, any operational noise effects from the Lease Area are likely to be of low intensity and highly localized. Tougaard et al. (2009b) concluded that marine mammals would be able to detect operational noise within a few thousand feet of WTGs. This suggests the potential for a reduction in effective communication space within the wind farm environment for marine mammals that communicate primarily in frequency bands below 8 kilohertz (kHz). This localized, long-term impact would constitute a minor effect on marine mammals belonging to the LFC hearing group (COP Appendix U2, Table 7; SouthCoast Wind 2023).

Based on the current available data, underwater noise from WTG operations from offshore wind activities is unlikely to cause PTS in ESA-listed marine mammals. Therefore, exposure of noises above PTS thresholds from WTG operations and for all ESA-listed marine mammals is considered extremely unlikely to occur and **discountable**. Therefore, the effects of noise exposure from Project WTG operations leading to PTS **may affect, not likely to adversely affect** any ESA-listed marine mammals.

[9] These are 50th and 90th percentile levels in the 20–447 hertz frequency band for monitoring locations RI-1, RI-2, and RI-3, as reported by Kraus et al. (2016).

As the Project area is near Nantucket Shoals, noise exposure from WTG operations may affect migratory and foraging behavior in ESA-listed mammals in this area. Timing of migrations includes a northward migration during March and April and a southward migration during November to December between summer feeding and winter calving grounds. During this migration period, adults may be accompanied by calves and periodically feed and rest along their migration route. Fin whales are present in the area year-round. Fin whales, sei whales, and blue whales generally prefer the deeper waters of the continental slope and more often can be found in water greater than 295 feet (90 meters) deep (Hain et al. 1985; Waring et al. 2011; Hayes et al. 2020). Underwater noise emitted by WTGs are generally in the lower frequency spectrum below 2,000 hertz (Hz) and overlap with the hearing sensitivity and communications used by LFCs. The full extent of how WTG operations may affect LFC behavior is unknown. NARWs do not appear particularly sensitive to other low frequency sounds emitted by vessels (Nowacek et al. 2004); however, the animals may still be adversely affected by noise stimuli even in the absence of overt behavioral reactions (Rolland et al. 2012). Cetaceans are not expected to be significantly disrupted from foraging if exposed to underwater noise from WTG operations but may forage less efficiently due to increased energy spent due to avoidance behavior. Decreased foraging efficiency, especially if individuals move away from Nantucket Shoals, could have short-term metabolic effects resulting in physiological stress, but these effects would dissipate once the prey distribution no longer overlaps the underwater noise.

Behavioral disturbance from WTG operations is not expected to impede the migration of NARWs to critical habitats located to the north and south of the Lease Area as animals would be able to travel beyond the disturbance area around the Lease Area (should they avoid it). The energetic consequences of any avoidance behavior or masking effects and potential delay in resting or foraging 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 calving. Any TTS effects would be expected to resolve within a few days to a week of exposure and are not expected to affect the health of any individual whale or its ability to migrate, forage, breed, or calve.

Masking of LFC communications is considered likely but as with behavioral disturbance, the extent of these effects is unknown. NARWs appear to be particularly sensitive to the effects of masking by underwater anthropogenic noise and have faced significant reductions in their communication space. Calling right whales in the Stellwagen Bank National Marine Sanctuary were exposed to noise levels greater than 120 dB re 1 µPa for 20% of the time during peak feeding months (Hatch et al. 2012). Communication disruptions caused by anthropogenic noise have implications on the physiological health of NARWs with potential population-level consequences. Over the last 50 years NARWs have been reported to shift their "upcalls" (communication used between mother and calf during separation events) to a higher-frequency band (Tennessen and Parks 2016). Rolland et al. (2012) identified an association between exposure to low frequency ship noise and an increase in stress-related metabolites in NARWs, which can potentially contribute to poorer reproductive success and immune suppression. Anthropogenic noise has also been highlighted as a probable cause for shifts in NARW distribution between 2004 and 2014, with decreased relative detections in the Gulf of Maine and increases in the Mid-Atlantic region after 2010 (Davis et al. 2017). Reduced communication space caused by anthropogenic noise could potentially contribute to the population fragmentation and dispersal of the NARW (Hatch et al. 2012; Brakes and Dall 2016).

The Lease Area does not extend beyond the continental slope where sperm whales are more commonly observed. If sperm whales are exposed to underwater noise above behavioral thresholds, effects would be confined to the Project area. Sperm whales would be expected to resume pre-exposure activities once the animal moves out of the disturbance zone. Masking of high-frequency echolocation clicks used by sperm whales is not anticipated; however, some masking of other communications used by this species is possible. These effects are not expected to overlap with areas frequently used by this species or in areas where they hunt for preferred prey (i.e., squid in deep waters).

Jansen and de Jong (2016) and Tougaard et al. (2009a) concluded that marine mammals would be able to detect operational noise within a few thousand feet of 2 MW WTGs, but the effects would have no significant impacts on individual survival, population viability, distribution, or behavior. Lucke et al. (2007) exposed harbor porpoise to simulated noise from operational wind turbines and found masking effects at 128 dB re 1 μPa in the frequencies 0.7, 1,000, and 2,000 hertz. This suggests the potential for a reduction in effective communication space within the wind farm environment for marine mammals that communicate primarily in frequency bands below 2,000 hertz.

While ESA-listed marine mammals may still be exposed to noise levels above the behavioral threshold, such exposure would be brief while they transit through the wind farm. Any effects associated with behavioral responses to these brief exposures are expected to be too small to be meaningfully measured or detected and are thus **insignificant**. Given the small scale of anticipated effects, the effects of noise exposure generated by WTG operations from the Project leading to behavioral disturbance **may affect, not likely to adversely affect** any ESA-listed marine mammals.

5.3.3.2 Sea Turtles

Maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects. Additionally, noise levels are expected to reach ambient levels within a short distance of turbine foundations (Kraus et al. 2016; Thomsen et al. 2015) and studies suggest that sea turtles may acclimate to repetitive underwater noise in the absence of an accompanying threat (Bartol and Bartol 2011; Hazel et al. 2007; U.S. Navy 2018). Therefore, no WTG noise impacts on ESA-listed sea turtles are anticipated.

Although some noise associated with operation of WTGs would be audible to sea turtles in wind energy areas, measurable impacts from this noise are not expected because it is likely to be at or below ambient levels only a short distance from the WTG. Sound generated by WTG aerodynamics and mechanical vibration may result in long-term, continuous underwater noise in the offshore environment. Underwater operational noise generated by offshore WTGs less than 6.15 MW has been measured to have SPLs ranging from around 80 to 135 dB re 1 μPa at various distances with frequencies between 10 hertz and 8 kilohertz, and the combined noise levels from multiple turbines would be lower or comparable to those of a small cargo ship (Tougaard et al. 2020). Operational noise from larger WTGs on the order of 15 MW would generate higher SPL levels of 125 dB re 1 μPa measured 328 feet (100 meters) from the turbine during 22 miles per hour (10 meters per second) wind speeds (Tougaard et al. 2020). Stöber and Thomsen (2021) created a linear model based on the maximum received wind levels from operational wind farms and estimated that a 10 MW wind turbine could yield broadband SPL source levels of 170 dB re 1 μPa-m, respectively. However, this would only be expected during extreme weather events, and Stöber and Thomsen expect that the industry shift from using gear boxes to direct-drive technology will reduce the sound level by 10 dB. Based on the current available data, underwater noise from turbine operations is unlikely to cause PTS or TTS in sea turtles but could cause behavioral effects. It is expected that these effects would be at relatively short distances from the foundations and as the sound would reach ambient underwater noise levels within 164 feet (50 meters) of the foundations (Miller and Potty 2017; Tougaard et al. 2009b). Sea turtles would be expected to habituate to the noise.

Based on the source levels presented above, it is unlikely that received levels of underwater noise from WTG operations would exceed PTS or TTS thresholds for sea turtles, therefore, the potential for ESA-listed sea turtles to be exposed to noise above PTS or TTS thresholds is considered extremely unlikely to occur and is **discountable**. The effects of noise exposure from Project WTG operations leading to PTS or TTS **may affect, not likely to adversely affect** ESA-listed sea turtles.

Underwater noise from WTG operations could exceed behavioral thresholds and cause masking of communications. However, more acoustic research is warranted to characterize sound levels originating from large direct-drive turbines, the potential for those turbines to cause behavioral effects, and to what distance behavioral and masking effects are likely. Popper et al. (2014) suggests that in response to continuous sounds, sea turtles have a high risk for behavioral disturbance in the near field (e.g., tens of meters), moderate risk in the intermediate field (hundreds of meters) and low risk in the far field (thousands of meters).

Sea turtles may be exposed to noise levels that exceed behavioral thresholds during WTG operations, particularly during high wind events when ambient underwater noise levels are also elevated, and behavioral reactions may include avoidance of the area (Hazel et al. 2007). Foraging sea turtles are not expected to be significantly interrupted foraging if exposed to underwater noise from WTG operations but may forage less efficiently due to increased energy spent due to avoidance behavior. Decreased foraging efficiency, especially if individuals move away from Nantucket Shoals, could have short-term metabolic effects resulting in physiological stress, but these effects would dissipate once the prey distribution no longer overlaps the underwater noise. Given the interim definition for ESA harassment, the animals ability to avoid harmful noises, the potential for ESA-listed sea turtles to be exposed to underwater noise exceeding behavioral thresholds from WTG operations would not rise to the level of take under the ESA and is therefore considered **insignificant**. Therefore, the effects of noise exposure from Project WTG operations leading to behavioral disturbance **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.3.3.3 Fish

Noise produced from operating WTGs is within hearing range of most marine fish. As described previously, noise levels from turbines are also expected to reach ambient levels within a short distance of turbine foundations (Kraus et al. 2016; Thomsen et al. 2015). Depending on the noise intensity, such noises could disturb or displace fish within the surrounding area or cause auditory masking (MMS 2007). As noise levels from WTG operations are expected to be low, fish would only be affected at close range (within 328 feet [100 meters]) (Thomsen et al. 2006, 2020). Thomsen et al. (2006) reviewed the observations of fish behaviors in proximity to an operational WTG and found varying results from no perceived changes in swimming behavior of European eels (*Anguilla anguilla*) and either increased or decreased catch rates of cod within 328 feet (100 meters) of the operational WTGs.

Available data on large direct-drive turbines are sparse. Direct-drive turbine design eliminates the gears of a conventional wind turbine, which increases the speed at which the generator spins. Direct-drive generators are larger generators that produce the same amount of power at slower rotational speeds. Only one study on direct-drive turbines presented in Elliott et al. (2019) was available in the literature. The study measured SPLs of 114 to 121 dB re 1 µPa SPL_{rms} at 164 feet (50 meters) for a 6 MW direct-drive turbine. Recent modeling conducted by Stöber and Thomsen (2021) and Tougaard et al. (2020) suggest that operational noise from larger, current-generation WTGs would generate higher source levels (170 to 177 dB re 1 µPa SPL_{rms} for a 10-MW WTG) than the range noted above from earlier research. However, the models were based on a small sample size, which adds uncertainty to the modeling results. In addition, modeling results were based on measured SPLs from geared turbines. Even though current turbine engines are larger, WTGs with direct-drive technology could reduce SPLs because they eliminate gears and rotate at a slower speed than the conventional geared generators.

Based on the source levels presented above and given that turbine noise is considered a non-impulsive, low-intensity sound source, it is unlikely that received levels of underwater noise from WTG operations would exceed physiological injury thresholds for Atlantic sturgeon, therefore, the potential for ESA-listed Atlantic sturgeon to be exposed to noise above physiological injury thresholds is considered extremely unlikely to occur and is **discountable**. The effects of noise exposure from Project WTG operations leading to physical injury **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

Based on the available source levels and modeling information presented above, underwater noise from WTG operations could exceed TTS and behavioral thresholds and cause masking of communications. Depending on turbine type and size and the overlap of natural (e.g., wind and waves) and anthropogenic (e.g., vessel noise) noise sources, sound produced by WTG operations could disturb or displace fish within the surrounding area. However, with generally low noise levels, an individual would be affected only at close ranges (within 100 meters) to the operating WTG (Thomsen et al. 2006, 2020).

As described above, it is expected that Atlantic sturgeon would occur intermittently in the Lease Area throughout their spring and fall migrations and may forage opportunistically in areas where benthic invertebrates are present. The area is not known to be a preferred foraging area and has not been identified as an aggregation area which reduces the potential for impact on this species from long-term operation noise. Given the interim definition for ESA harassment, the animals ability to avoid harmful noises, and the intermittence of foraging and aggregation in the Lease Area, the likelihood for ESA-listed Atlantic sturgeon to be exposed to underwater noise exceeding TTS/behavioral thresholds or masking is expected to be low and would not rise to the level of take under the ESA and is therefore considered **insignificant**. Therefore, the effects of noise exposure from Project WTG operations leading to TTS/behavioral disturbance and masking **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.3.4 Summary of Other Noise Effects

5.3.4.1 Marine Mammals

Underwater noise generated by vessels, helicopters, and WTGs associated with the Proposed Action would not result in injury to ESA-listed marine mammals, but these noise sources do have the potential to elicit behavioral responses in these species. Based on the low source levels and rapid attenuation of WTG noise, associated behavioral effects on marine mammals are expected to be too small to be meaningfully measured. Any behavioral effects associated with vessel or helicopter noise would be temporary and are not expected to be biologically significant. Vessel noise may also result in temporary stress responses and masking, which could affect individual ESA-listed species but are not expected to result in stock or population-level effects based on the small number of Project vessels anticipated for the Proposed Action.

5.3.4.2 Sea Turtles

Underwater noise generated by vessels, helicopters, and WTGs associated with the Proposed Action would not result in injury to ESA-listed sea turtles. Based on the low source levels, WTG noise would also not result in behavioral effects on sea turtles. Vessel and helicopter noise may result in behavioral effects. However, these effects are considered unlikely given the patchy distribution of sea turtles in the Action Area and the relatively small number of vessels and aircraft associated with the Proposed Action. Any behavioral effects associated with vessel or aircraft noise would be temporary and localized and are not expected to result in stock or population-level effects.

5.3.4.3 Fish

Underwater noise generated by vessels, helicopters, and WTGs associated with the Proposed Action would not result in injury to Atlantic sturgeon but may elicit behavioral responses in this species. Based on the low source levels, the intermittent presence of Atlantic sturgeon in the Lease Area, and the rapid attenuation of WTG noise, behavioral effects on Atlantic sturgeon would be too small to be meaningfully measured and would not interfere with foraging and reproduction. Helicopter noise has the potential to result in behavioral effects, but such effects are unlikely given Atlantic sturgeon’s demersal life history.

Therefore, the risk of behavioral effects associated with helicopter noise is discountable. Vessel noise may cause behavioral effects, but such effects would be most likely to occur in the upper portion of the water column where demersal Atlantic sturgeon are unlikely to occur. Any behavioral effects on ESA-listed fish species would be temporary and localized, and these impacts are unlikely to adversely affect individuals.

5.4 Effects of Vessel Traffic

As detailed in Section 3.1.2.6, a variety of vessels would be used to construct, operate, and decommission the Proposed Action. SouthCoast Wind expects a daily average of 15-35 vessels depending on construction activities with a maximum peak of 50 vessels in the Lease Area at one time. Vessels are expected to be in use during any phase of the Proposed Action. Vessel traffic associated with the Proposed Action could affect ESA-listed species through vessel strikes (Section 5.4.1) or discharges of fuel, fluids, hazardous material, trash, or debris from Proposed Action vessels (Section 5.4.2). Following the assessment of these effects, a summary of overall vessel traffic effects on ESA-listed species is provided (Section 5.4.3). In addition to increased risk of vessel strike and accidental vessel discharges, vessels produce underwater noise, which was evaluated in Section 5.3.1. Vessels would also produce artificial lighting, which is addressed in Section 5.5.9, and air emissions, which are addressed in Section 5.7.

5.4.1 Risk of Vessel Strike

The Proposed Action would result in increased risk of vessel encounters for some ESA-listed species due to increased vessel traffic during the construction, O&M, and decommissioning phases of the Project. Vessel strikes are a known source of injury and mortality for marine mammals, sea turtles, and Atlantic sturgeon. Based on the vessel traffic generated by the proposed Project, a daily average of 15-35 vessels depending on construction activities with a maximum peak of 50 vessels could be present in the Lease Area at one time during the construction phase. The presence of these vessels could cause delays for non-Proposed Action vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port.

5.4.1.1 Marine Mammals

Vessel strikes are a significant concern for marine mammals, including NARWs, which are relatively slow swimmers and inhabit areas of high vessel traffic. Vessel strikes are relatively common for marine mammals (Rockwood et al. 2017; Kraus et al. 2005) and are a known or suspected cause of the three active unusual mortality events (UMEs) in the Atlantic Ocean for marine mammals (humpback whale, minke whale, and NARW). Vessel strikes may be particularly significant for NARWs, for which vessel strikes are a primary cause of death (Kite-Powell et al. 2007; Garrison et al. 2022). Vessels of all sizes have the potential to cause lethal injury to large whales during a strike, and larger vessels may be able to produce enough force to cause lethal strikes even at reduced speeds (10 knots) (Kelley et al. 2021). Marine mammals are expected to be most vulnerable to vessel strikes when swimming within the vessel's draft and not detectable by visual observers (e.g., animal below the surface or poor visibility conditions such rough sea state or low light). The probability of vessel strike increases with increasing vessel speed (Pace and Silber 2005; Vanderlaan and Taggart 2007); NARWs are at highest risk for vessel strike when vessels travel in excess of 10 knots (Kelley et al. 2021; Vanderlaan and Taggart 2007). Serious injury to marine mammals due to vessel collision rarely occurs when vessels travel below 10 knots (Laist et al. 2001).

A vessel strike on a marine mammal may result in either injury or mortality. Injuries are typically the result of one of two mechanisms: blunt force trauma from impact with the vessel or lacerations from contact with the propellers (Wiley et al. 2016). Depending on the severity of the strike and the injuries inflicted, the individual may or may not recover (Wiley et al. 2016). The orientation of the marine mammal with respect to vessel trajectory will affect the severity of the injury (Martin et al. 2016; Vanderlaan and Taggart 2007). Other factors that affect the probability of a marine mammal-vessel strike and its severity include:

- Number, species, age, size, speed, health, and behavior of animal(s) (Martin et al. 2016; Vanderlaan and Taggart 2007);
- Number, speed, and size of vessel(s) (Martin et al. 2016; Vanderlaan and Taggart 2007);
- Habitat type characteristics (Gerstein et al.; Blue 2005; Vanderlaan and Taggart 2007);
- Operator's ability to avoid collisions (Martin et al. 2016); and
- Vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007).

The following factors can also impair the ability of a marine mammal to detect and locate the sound of an approaching vessel:

- Attenuation of low frequency vessel sound near the surface (i.e., Lloyd mirror effect);
- Decreased propeller sound at the bow as a vessel's length increases (i.e., spreading loss);
- Impedance of forward-projecting propeller sound due to hull shape and relative placement of keel (above-keel propeller location resulting in acoustic shadowing); and
- Ambient (background) sound interfering with the sound of an approaching vessel (i.e., acoustic masking).

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of large vessels inhibit the ability of crew to detect and react to marine mammals along the vessel's transit route. In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand, or were seen too late to be avoided. Laist et al. (2001) reported that the most lethal or severe injuries are caused by ships 262 feet (80 meters) or longer travelling at speeds greater than 13 knots (6.69 meters per second). A more recent analysis conducted by Conn and Silber (2013) built upon collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005) and included new observations of serious injury to marine mammals as a result of vessel strikes at slower speeds (e.g., 2 and 5.5 knots). The relationship between lethality and strike speed was still evident; however, the speeds at which 50 percent probability of lethality occurred was approximately 9 knots (10.4 miles per hour [4.6 meters per second]). Smaller vessels have also been involved in marine mammal collisions. Minke, humpback, and fin whales have been killed or fatally wounded by whale-watching vessels around the world (Jensen and Silber 2004). Strikes have occurred when whale watching boats were actively watching whales as well as when they were transiting through an area, with the majority of reported incidences occurring during active whale watching activities (Laist et al. 2001; Jensen and Silber 2004).

Vessels of all sizes may pose a risk, but larger vessels may produce lethal strikes at speeds as low as 10 knots (Kelley et al. 2021). Large vessels that would be used for the Proposed Action include heavy lift vessels, monopile supply vessels, WTG installation vessels, heavy transport vessels, cable lay vessels, pre-lay grapnel run vessels, construction support vessels, and tugs and barges (Table 3.1-15). The remaining Project vessels (i.e., crew transfer vessels, safety vessels) would be smaller and more maneuverable, with smaller in-water hulls relative to larger construction vessels. However, maximum vessel speeds may be as fast as 35 knots and these higher speeds reduce reaction time for both the marine mammal and for the vessel operator conducting a maneuver to avoid the marine mammal.

Vessel collision risk is expected to be highest during construction, when traffic volumes would be greatest, and when vessels are transiting to and from the Lease Area and ports. Vessels actively engaged in construction (i.e., jack-up vessels) are expected to be largely stationary and travel at slow speeds when transiting between locations within the Lease Area.

A range of mitigation measures will be implemented to avoid, minimize, and mitigate impacts on marine mammals associated with vessel traffic (Section 3.3, Table 3.3-1 and Table 3.3-2). This includes strict adherence to NMFS Regional Viewing Guidelines (NMFS 2023p) for vessel strike avoidance and reporting protocols (Table 3.3-2, BA-12, BA-13). General measures for vessel strike avoidance require all underway vessels, including those transiting to and from local ports to have a dedicated trained visual observer or NMFS-approved PSO on duty at all times to monitor for marine mammals. Visual observers must be equipped with alternative monitoring technology during periods of low visibility (e.g., darkness, rain, and fog). Observers will monitor the NMFS NARW reporting system from November 1 through April 30 and whenever a dynamic management area (DMA) is established in the operational area. All vessels, regardless of size, would be required to comply with NMFS regulations and speed restrictions (≤10 knots) in NARW management areas including seasonal management areas (SMA) and active DMAs during migratory and calving periods from November 1 to April 30 (Table 3.3-1 and Table 3.3-2, BA-7). All vessels, will reduce speed to ≤10 knots when mother/calf pairs, pods, or large assemblages of marine mammals are observed. A PAM system will be developed consisting of near real-time monitoring such that NARW or other large whale calls made in or near the transit corridor can be detected and transmitted to the transiting vessel. The detections will be used to determine areas along the transit corridor where vessels would be allowed to travel at > 10 knots when no other speed restrictions are in place (e.g., 10-knot speed restriction in SMAs and DMAs). Separation distances would be required between the vessel and sighted NARWs or unidentified large marine mammals, including the actions taken by the vessel when a marine mammal is in the vicinity. These actions include active avoidance of spotted NARWs at 10 knots or less, shifting engines to neutral in the event a NARW approaches the vessel, and reporting protocols for dead and/or injured marine mammals (Table 3.3-2, BA-12, BA-13).

Project-specific training will be provided to all vessel crew members, visual observers, and trained lookouts to ensure that the presence of marine mammals are continuously being monitored and to initiate vessel strike avoidance measures (e.g., speed restrictions and course corrections) when marine mammals are present (BA-4 to BA-8). Near real-time communication would be required among Project vessels working in the same area when ESA-listed species are sighted (marine mammals and sea turtles) (BA-6). Vessels of all sizes operating port to port will be required to reduce speeds to 10 knots or less between November 1 and April 30 and that vessel speed reductions in SMAs, DMAs, slow zones, and when marine mammals are sighted are followed (BA-7). Vessel operators would be required to check daily for NARW sightings and adhere to separation distances and full-stop procedures when ESA-listed marine mammals are encountered (BA-8).

Vessel strikes are not anticipated when mitigation measures are effectively implemented; thus, the potential for vessel strikes to ESA-listed marine mammals is extremely unlikely. Given the low likelihood of vessel strikes, the risk of vessel strikes is **discountable.** Therefore, the effects of vessel traffic resulting to vessel strike due to the Proposed Action **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.4.1.2 Sea Turtles

Vessel strikes are an increasing concern for sea turtles. A study of stranded sea turtles in Florida found that one third of loggerhead and leatherback sea turtles and a quarter of Kemp's ridley sea turtles had suffered a vessel strike injury (Foley et al. 2019). The percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem

(NMFS and USFWS 2007a). Sea turtles are expected to be most vulnerable to vessel strikes in coastal foraging areas and may not be able to avoid collisions when vessel speeds exceed 2 knots (Hazel et al. 2007).

From 50 – 500 loggerhead sea turtles and 5 – 50 Kemp's ridley sea turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC 1990). This report is dated and also indicates that this estimate is highly uncertain and could be a large overestimate or underestimate. The Recovery Plan for loggerhead sea turtles (NMFS and USFWS 2008) notes that, from 1997 to 2005, 15 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having some type of propeller or collision injuries although it is not known what proportion of these injuries occurred before or after the turtle died. Increased vessel traffic associated with the Proposed Action will increase the potential for impacts from vessel strikes.

Several factors contribute to the probability of vessel strikes, including the sea turtle density, time of year, sea turtle submergence rates, vessel type and speed, vessel trip numbers, and vessel trip distances. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged, during which time they may not be susceptible to vessel strikes. Sea turtles spend at least 20 to 30 percent of their time at the ocean surface (Lutcavage and Lutz 1997) during which time they would be vulnerable to being struck by vessels or vessel propellers. With the exception of leatherbacks, sea turtles prefer to stay within the first few meters of the water's surface. Information on swim depth is provided in the Navy Undersea Warfare Center's dive distribution and group size parameter reports (Borcuk et al., 2017; Watwood and Buonantony, 2012). These data suggest loggerhead and green sea turtles spend 60 – 75 percent of their time within 33 feet (10 meters) of the surface; leatherback sea turtles spend about 20 percent of their time within 33 feet (10 meters) of the water surface, and there is insufficient data to quantify Kemp's ridley sea turtle activity. Any sea turtle found in the Action Area could thus occur at or near the surface, whether resting, feeding, or periodically surfacing to breathe. Sea turtle densities in the Action Area are mainly driven by forage availability and measures to avoid transiting through areas of visible jellyfish aggregations or floating *Sargassum* lines or mats would effectively reduce collision risk.

Sea turtles are only present seasonally in the Project Area and are expected primarily between June and October with a few individuals present during spring and winter. Sea turtle density estimates compiled by O'Brien et al. (2021;2022) from survey campaigns 6A (March-October 2020) and campaign 6B (November 2020-October 2021) recorded 15 detections of 20 turtles (campaign 6A) and 45 detections of 51 sea turtles (campaign 6B). During campaign 6A, three leatherback sea turtles, two loggerhead sea turtles, and one unidentified sea turtle were observed. The majority of sightings occurred in the fall and only three sightings occurred in the summer (all in July). Leatherback turtles were sighted on four separate days, and all sightings except one were over the Nantucket Shoals. Seasonal sighting rates were higher in the fall (5.81 turtles/kilometer) than in the summer (0.19 turtles/kilometer). Only two loggerhead turtles were detected during campaign 6A; one was in the central part of OCS-A-0501 and one in OCS-A 0486.

During campaign 6B, 18 sightings of 19 leatherback turtles were observed during general surveys. Sea turtles were sighted in 5 months in both summer (25 sightings of 26 individuals) and fall (20 sightings of 25 individuals). Leatherback turtles were predominantly sighted over the Nantucket Shoals. Seasonal sighting rates were 3.3 turtles/kilometers (fall 2020), 5.3 turtles/kilometers (summer), and 2.9 turtles/kilometers (fall 2021). No turtles were sighted in winter or spring. One loggerhead turtle and one unidentified sea turtle were detected during campaign 6B, and both of these sightings were in the Nantucket Shoals area. For leatherbacks in particular, the greatest residency times (derived from analyzed tagging data of 20 leatherbacks) in Southern New England waters that encompass the Project area were up to 60 days in the summer. By fall, leatherbacks were no longer present in the Project area or Nantucket Shoals. Leatherbacks spent time in Cape Cod Bay and in the Mid-Atlantic bight for up to 60 days; by the winter and spring leatherbacks were located far offshore and in southwestern Atlantic waters from roughly the DelMarVa region to South America (Dodge et al. 2014). Vessels transiting from Port of Salem, Massachusetts and Canadian ports could potentially transit across Nantucket Shoals, where the greatest numbers of turtles were observed. However, these vessels would be able to avoid Nantucket Shoals via the Cape Cod Canal or by transiting through the Vineyard Sound.

There are limited measures that have been proven to be effective at reducing collisions between sea turtles and vessels (Schoeman et al. 2020). A range of mitigation and monitoring measures have been proposed and will be implemented that would serve to reduce the probability of a vessel strike, especially during peak vessel activity (Table 3.3-2). These measures include reducing vessel speed to 4 knots if a sea turtle is sighted within 328 feet (100 meters) of the operating vessel's forward path (BA-10). The vessel must then move away from the sea turtle until a 328-foot (100 meter) separation distance is achieved. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the individual at a speed of 4 knots or less until there is a separation distance of at least 328 feet (100 meters), at which time normal vessel operations may be resumed. Adherence to reporting protocols and training personnel to watch for and report the presence of sea turtles would further increase vigilance to avoid striking sea turtles (Table 3.3-2, BA-4, BA-5, BA-6, BA-12, BA-13). Lookouts can advise vessel operators to slow the vessel or maneuver safely away from sea turtles, as well as observe for indicators of sea turtle presence such as drifting algal mats. Additionally, from June 1 through November 30, all vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation, or slow down to 4 knots while transiting such areas. Further, crew members will be briefed on the identification of sea turtles, and the process for reporting sea turtles must be clearly communicated and posted in highly visible areas aboard all Project vessels.

Dedicated PSOs will conduct continuous monitoring of sea turtles during vessel transits and initiate vessel strike avoidance measures when sea turtles are present. It is important to consider, however, that due to their low-lying appearance or when they are just below the surface but within the vessel's draft, sea turtles will be challenging to detect from a moving vessel at sufficient distance to avoid vessel strike. The ability to detect becomes more challenging when compounded with low-visibility conditions. During periods of low visibility (e.g., darkness, rain, and fog), visual observers will be equipped with alternative monitoring technology (BA-15) in efforts to reduce such risks. It is anticipated that potential exposure to vessel strike risk would be limited to sea turtles within surface habitats in the transit path between ports and the Lease Area. As discussed in Section 3.1.2.6, a daily average of 15-35 vessels depending on construction activities with a maximum peak of 50 vessels during construction is expected in the Lease Area. While Project vessel traffic would result in a measurable increase in vessel traffic in the Lease Area, this increase is relatively low compared to the surrounding areas. Sea turtles are also expected to be highly dispersed in the Lease Area and the likelihood of co-occurrence between Project vessels and sea turtles is expected to be low.

While the probability of vessel interactions with sea turtles is generally low due to their seasonal presence with dispersed regional distribution, some unavoidable effects on sea turtles may still occur. This is primarily because sea turtles can be challenging to detect during transits, especially during periods of low visibility. Thus, vessel traffic leading to collisions with sea turtles cannot be discounted. In the event that ESA-listed sea turtles occur in the Action Area, the implementation of mitigation measures mentioned above would lower the risk of vessel strikes, though not entirely eliminate the risk. Therefore, the effects of vessel traffic resulting from vessel strike due to the Proposed Action **may affect, likely to adversely affect** ESA-listed sea turtles.

5.4.1.3 Fish

Vessel strikes are a documented source of mortality for Atlantic sturgeon in riverine habitats (Brown and Murphy 2010; Balazik et al. 2012). In one study, Balazik et al. (2012) assessed the potential for vessel interactions with adult Atlantic sturgeon in the James River, in Virginia. Carcasses from 2007 to 2010 were recovered with obvious signs of vessel strike mortality from the tidal freshwater portion of the river, as the carcasses were recovered from river kilometers 70 to 127, far from the coastal mouth. In this upriver portion, the river is maintained by the Army Corps of Engineers to a minimum depth of 24.9 feet (7.6 meters) and minimum width of 299.9 feet (91.4 meters). Importantly, these mortalities are likely the result of deep draft (≤ 24 feet [7.3 meters]) ocean cargo vessels traveling to upriver ports. The greatest number of vessel strike mortality carcasses recovered from 2007 to 2010 occurred in an area of the river comparatively narrower and shallower than the waters near the mouth of the river, over habitat types preferred by adult Atlantic sturgeon, where the draft and propeller depth of ocean cargo vessels overlapped with the depth preference of Atlantic sturgeon (Balazik et al. 2012). While deep-draft vessels may be most likely to result in sturgeon injury or mortality in these habitats, vessel interactions are not limited to deep-draft vessels (NMFS 2018c).

In contrast to habitat reviewed in the Balazik study, there are no Project ports located as far upriver, nor within the depth or width ranges, where vessel strikes likely occurred. Only one Project port is located upriver, the Port of Providence. The Port of Providence is located 5 miles (8 kilometers) upriver, in waters approximately 40 feet (12 meters) deep and 2,023 feet (616 meters) wide (NOAA Chart 13224). Other rivers that are farther “upstream” of the coast are the Port of Fall River located at the mouth of the Taunton River, draining into Mount Hope Bay, and the Sparrows Point Port located at the mouth of the Patapsco River, draining into the Chesapeake Bay. The other Project ports occur in large bays or at the mouths of rivers draining directly into the ocean; these wider areas allow Atlantic sturgeon freedom of movement not found in the narrow upriver habitats, reducing the risk of vessel encounters. None of the ports where Atlantic sturgeon could feasibly occur, or the approaches to the ports, from the Port of Davisville to the Port of Charleston, are in areas where a vessel strike would likely occur, as these areas are comparatively deeper and wider than the areas investigated in Balazik et al. (2012). In the coastal and marine environment, demersal Atlantic sturgeon would have greater spatial separation from vessel hulls due to deeper water and increased ability to avoid vessels (i.e., as opposed to within the confines of a shallower and narrower river), so the risk of vessel strike would be significantly lower.

Mitigation measures that would avoid or reduce vessel strike risk for marine mammals and sea turtles may also benefit ESA-listed fish species (BA-4 to BA-13, Table 3.3-2). Given the small incremental increase in vessel traffic due to Project vessels compared to existing traffic and the limited time when Project vessels would travel in comparatively shallower narrower waterways during the construction phase, the increased collision risk for Atlantic sturgeon is expected to be very small, and thus, **insignificant**. Therefore, the effects of vessel traffic resulting to vessel strike due to the Proposed Action **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.4.2 Vessel Discharges

The Proposed Action may increase accidental releases of fuels, fluids, and hazardous materials and trash and debris due to increased vessel traffic. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur to some extent during O&M and decommissioning.

5.4.2.1 Marine Mammals

Marine mammal exposure to fuel, fluid, or hazardous material releases through aquatic contact or inhalation of fumes can result in death or sublethal effects, including but not limited to adrenal effects, hematological effects, hepatological effects, poor body condition, and dermal effects (Kellar et al. 2017;

Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). In addition to direct effects on marine mammals, accidental releases can indirectly affect these species through impacts on prey species. Given the relatively small volumes of fuels, fluids, and hazardous materials potentially involved in vessel discharges and the likelihood of release occurrence, the increase in accidental releases associated with the Project vessel discharges is expected to fall below the range of releases that occur on an ongoing basis from other activities.

About half of all marine mammal species worldwide have been documented to ingest trash and debris (Werner et al. 2016), which can result in death. Based on stranding data, mortality rates associated with debris ingestion range from 0 to 22 percent (BOEM 2021a). Ingestion may also result in sublethal effects, including digestive track blockage, disease, injury, and malnutrition (Baulch and Perry 2014). Linkages between impacts on individual marine mammals associated with debris ingestion and population-level effects are difficult to establish (Brown et al. 2015). BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects such releases would be small and infrequent. The amount of trash and debris accidentally discharged from Project vessels during construction, O&M, and decommissioning would be miniscule compared to other ongoing and future trash releases.

The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste further reducing the likelihood of an accidental release. In addition, SouthCoast Wind has developed an OSRP (COP Appendix AA, SouthCoast Wind 2023) with measures to avoid accidental releases and a protocol to respond to such a release if one occurs. SouthCoast Wind will adhere to all regulations under the USEPA Clean Water Act. Mitigation measures will be implemented to minimize the accumulation of marine debris from lost gear, including conducting marine debris awareness training to all individuals onboard vessels for Project-related activities, prohibiting the disposal of trash overboard, and in the event of an accidental release of trash, ensuring that efforts are made to retrieve the debris and report the incident to BSEE (Table 3.3-2, BA-29, BA-30, BA-31). Therefore, effects due to accidental releases are considered unlikely.

Based on the small contribution of Proposed Action vessel discharges to ongoing and future releases, the Proposed Action would not result in a measurable increase in accidental releases in the Action Area. Given the low likelihood of occurrence and the mitigation measures in place to prevent accidental releases, the effects of vessel discharges on ESA-listed marine mammals would be **insignificant**. Therefore, the effects of vessel discharges associated with the Proposed Action **may affect, not likely to adversely affect** ESA-listed marine mammals**.**

5.4.2.2 Sea Turtles

Sea turtle exposure to oil spills through aquatic contact or inhalation of fumes can result in death (NOAA 2010) or sublethal effects, including but not limited to adrenal effects, dehydration, hematological effects, increased disease incidence, hepatological effects, poor body condition, and dermal and musculoskeletal effects (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; NOAA 2010; Vargo et al. 1986). Such sublethal effects would affect individual fitness but are not expected to affect sea turtle populations. In addition to direct effects on sea turtles, accidental releases can indirectly affect sea turtles through impacts on prey species. Given the relatively small volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the increase in accidental releases associated Project vessel discharges is expected to fall below the range of releases that occur on an ongoing basis from other activities.

All sea turtle species are known to ingest trash and debris, including plastic fragments, tar, paper, polystyrene foam, hooks, lines, and net fragments (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Such ingestion can occur accidentally or intentionally when individuals mistake the debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Ingestion of trash and debris can result in death or sublethal effects, including but not limited to dietary dilution, chemical contamination, depressed immune system, poor body condition, reduced growth rates, reduced fecundity, and reduced reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). These sublethal effects would affect individual fitness, but mortality and sublethal effects associated with ingestion of trash and debris are not expected to have population-level effects. The amount of trash and debris accidentally discharged from Project vessels would be miniscule compared to trash releases associated with other ongoing and future activities.

The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and SouthCoast Wind has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release if one occurs. SouthCoast Wind will adhere to all regulations under the USEPA Clean Water Act. Mitigation measures will be implemented to minimize the accumulation of marine debris from lost gear including conducting marine debris awareness training to all individuals onboard vessels for Project-related activities, prohibiting the disposal of trash overboard, and in the event of an accidental release of trash, ensuring efforts are made to retrieve the debris and report the incident to BSEE (Table 3.3-2, BA-29, BA-30, BA-31). Therefore, effects due to accidental releases are considered unlikely.

Given the proposed mitigation measures designed to minimize the event and effects of accidental releases, the low likelihood of a discharge, and given that the Proposed Action would not result in a measurable increase in accidental releases in the Action Area, the effects of vessel discharges on ESA-listed sea turtles would be **insignificant**. Therefore, the effects of vessel discharges associated with the Proposed Action **may affect, not likely to adversely affect** ESA-listed turtles**.**

5.4.2.3 Fish

Accidental releases of fuel, fluids, and hazardous materials can cause temporary, localized impacts on finfish, including increased mortality, decreased fitness, and contamination of habitat. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and includes BOEM-proposed measures to address accidental releases (Section 3.3).

The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and SouthCoast Wind has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release if one occurs. SouthCoast Wind will adhere to all regulations under the USEPA Clean Water Act. SouthCoast Wind will ensure the use of appropriate mooring gear that minimizes the risk of entanglement or entrainment of sea turtles that would just as likely benefit the Atlantic sturgeon. Further, mitigation measures will be implemented to minimize the accumulation of marine debris from lost gear including conducting marine debris awareness training to all individuals onboard vessels for Project-related activities, prohibiting the disposal of trash overboard, and in the event of an accidental release of trash, ensuring efforts must be made to retrieve the debris and reporting the incident to BSEE (Table 3.3-2, BA-29, BA-30, BA-31). Therefore, effects due to accidental releases are considered unlikely.

As noted in Section 5.4.2.1, the Proposed Action would not result in a measurable increase in accidental releases in the Action Area. Based on the low likelihood of discharge and the non-measurable increase in accidental releases associated with Project vessels, effects of vessel discharges on ESA-listed Atlantic sturgeon would be **insignificant**. Therefore, the effects of vessel discharges associated with the Proposed Action **may affect, not likely to adversely affect** Atlantic sturgeon**.**

5.4.3 Summary of Vessel Traffic Effects

5.4.3.1 Marine Mammals

The increased risk of vessel strike for marine mammals associated with the Proposed Action would be **discountable** based on the small incremental increase in vessel traffic and the measures that would be undertaken to avoid or minimize vessel strike risk. Project vessel discharges are unlikely to occur given the measures in place to avoid or minimize accidental releases, and vessel traffic associated with the Proposed Action would not result in a measurable increase in discharges in the Action Area. Therefore, effects from vessel discharges associated with the Proposed Action would be **insignificant** for all ESA-listed marine mammals.

5.4.3.2 Sea Turtles

Based on the small incremental increase in vessel traffic and the patchy distribution of sea turtles in the Action Area, the likelihood of vessel strikes is considered low. However, despite the potential effectiveness of mitigation measures in minimizing such risks, it cannot be completely discounted given the difficulty in detecting sea turtles during transits. Therefore, the increased risk of vessel strike associated with the Proposed Action **may affect, likely to adversely affect** ESA-listed sea turtles.. Project vessel discharges are unlikely to occur given the measures in place to avoid or minimize accidental releases, and vessel traffic associated with the Proposed Action would not result in a measurable increase in discharges in the Action Area. Therefore, effects from vessel discharges associated with the Proposed Action would be **insignificant** for all ESA-listed sea turtles.

5.4.3.3 Fish

Though vessel strike is a documented source of Atlantic sturgeon mortality in riverine habitats, the risks posed by vessel strike in oceanic habitats are uncertain, but are presumably less due to the deeper, more open-water environment on the OCS. The increased risk of vessel strike for Atlantic sturgeon associated with the Proposed Action would be **insignificant** based on the small incremental increase in vessel traffic, the patchy distribution of sturgeon in the Action Area, and the measures that would be undertaken to avoid or minimize vessel strike risk. Project vessel discharges are unlikely to occur given the measures in place to avoid or minimize accidental releases, and vessel traffic associated with the Proposed Action would not result in a measurable increase in discharges in the Action Area. Therefore, effects from vessel discharges associated with the Proposed Action would be **insignificant** for ESA-listed Atlantic sturgeon.

5.5 Habitat Disturbance/Modifications

Activities included in the Proposed Action would result in habitat disturbance or modifications that may cause impacts on benthic and water column habitat. Anticipated habitat disturbance or alterations may result from geophysical and geotechnical surveys (Section 5.5.1); habitat conversion and loss associated with the placement of WTGs, OSPs, submarine cables, cable protection, and scour protection (Section 5.5.2); turbidity (Section 5.5.3); dredging (Section 5.5.4); trenching (Section 5.5.5); the presence of offshore structures (Section 5.5.6 and 5.5.7); the addition of EMFs and heat (Section 5.5.8); lighting (Section 5.5.9); OSPs (Section 5.5.10), and entrainment of prey species from suction-bucket installation (Section 5.5.11). Individual activities and impacts are addressed in the following subsections. Following the assessment of these potential sources of habitat disturbance/modification, a summary of overall effects on ESA-listed species and associated prey is provided (Section 5.5.12). The effects analyses for Fisheries and Habitat Surveys and Monitoring are provided in the succeeding section (Section 5.6) and the effects analyses for Unexpected or Unanticipated Events (Section 5.10.2) such as accidental oil spills or chemical release from WTGs and OSPs are discussed in Section 5.10.2.3.

5.5.1 Geotechnical and Geophysical Surveys

As described in Section 3.1.2.7, HRG and geotechnical surveys would be conducted during the pre-construction and O&M phases of the Proposed Action. HRG surveys would not result in habitat disturbance or modification. Geotechnical surveys may cause benthic disturbance as a result of physical seafloor sampling. Geotechnical surveys would be limited to the pre-construction phase of the Project and would be conducted at specific WTG locations.

Each individual geotechnical sampling event would disturb a 10.8 to 107.6-square foot (1 to 10-square meter) area of seabed (BOEM 2014). Assuming all 147 WTG locations require geotechnical sampling, an area of up to 0.3 acres (1,470 square meters) would be disturbed.

BOEM and NMFS completed a programmatic consultation in compliance with section 7 of the ESA. This consultation resulted in Project Design Criteria (PDCs) and Best Management Practices (BMPs) for conducting HRG, geotechnical, and biological surveys in support of offshore wind development on the Atlantic OCS leases (GARFO PRD-BOEM 2021). There are eight PDCs:

1. Avoid Live Bottom Features,
2. Avoid Spawning and Developmental Habitat of Sturgeon,
3. Marine Debris Awareness and Elimination,
4. Minimize Interactions with Protected Species during Geophysical Survey Operations,
5. Minimize Vessel Interactions with Protected Species,
6. Minimize Risk During Buoy Deployment, Operations, and Retrieval,
7. Protected Species Observers, and
8. Reporting Requirements.

These PDCs will be carried out through the implementation of the BMPs. The BMPs to minimize interactions with Protected Species during Geophysical Survey Operations include 1,640-foot (500 meter) monitoring zones in all directions; 1,640-foot (500 meter) shutdown zones (NARWs); 328-foot (100 meter) shutdown (for all other ESA-listed whales); adherence to NMFS permit conditions under ITAs under the MMPA; preclearance observations before beginning noise producing activities; ramp-up, shutdown, and restart procedures; no surveys during peak NARW abundance (January 1 – May 15); separation distances between multiple surveys in the same area; loggerhead sea turtle protections when operating in nearshore critical habitat in the Southern U.S. and Gulf of Mexico from April 1 to September 30; and all observations of listed species by crew or project personnel must be communicated to PSOs on-duty.

The geotechnical and geophysical surveys described in Section 3.1.2.7 and this section are consistent with the scope of activities covered in the programmatic consultation, further evidenced by the applicant mitigation measures for the construction and operation phases of the project (Section 3.3, Table 3.3-1 and Table 3.3-2). SouthCoast Wind is requesting incidental take under the MMPA, and no take under the ESA is expected with the required mitigation.

5.5.1.1 Marine Mammals

Benthic impacts associated with geotechnical surveys for the Proposed Action would have **no effect** on ESA-listed marine mammals, which do not forage on benthic prey species.

5.5.1.2 Sea Turtles

Benthic disturbance associated with geotechnical surveys for the Proposed Action has the potential to reduce foraging habitat or prey availability for ESA-listed sea turtle species that forage in soft bottom habitats. These effects would be localized and short-term. Recolonization and recovery of prey species in disturbed sediment is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little time as 100 days (Dernie et al. 2003). Given the small size of individual disturbed areas and expected occurrence of similar, undisturbed benthic communities in the adjacent seabed, recolonization may occur relatively quickly following geotechnical surveys. Based on the short-term and localized nature of effects, the small area of disturbance, and the availability of similar foraging habitat throughout the Action Area, benthic habitat disturbance associated with geotechnical surveys for the Proposed Action would be **insignificant,** and **not likely to adversely affect** ESA listed sea turtles**.**

5.5.1.3 Fish

Benthic disturbance associated with geotechnical surveys for the Proposed Action has the potential to reduce foraging habitat or prey availability for Atlantic sturgeon in the Action Area. These effects would be localized and short-term. Recolonization and recovery of prey species in disturbed sediment is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little as 100 days (Dernie et al. 2003). As noted in Section 5.5.1.2, recolonization may occur relatively quickly following geotechnical surveys. Based on the short-term and localized nature of effects, the small area of disturbance, and the availability of similar foraging habitat throughout the Action Area, benthic habitat disturbance associated with geotechnical surveys for the Proposed Action would be **insignificant**, and **not likely to adversely affect** Atlantic sturgeon.

5.5.2 Habitat Conversion and Loss

Installation of WTGs, OSPs, submarine cables, and associated scour and cable protection during construction would result in habitat conversion and loss. Some soft-bottom habitat would be lost, and some soft-bottom and open water pelagic habitat would be converted to hard-bottom and vertical structured habitat, respectively. This habitat loss and conversion would last through the O&M phase and into decommissioning.

Seafloor habitats within the Lease Area and southern portions of the Falmouth and Brayton Point ECCs are homogenous sand plains, which are a prevalent feature on the OCS. Greater habitat complexity, including hard bottom habitats, are found in the northern portions of both ECCs as they enter state waters (Table 5.5-1). Communities well adapted to disturbance within their habitats (e.g., soft-sediment fauna dominant in sand habitats in the Lease Area and southern portions of the ECCs) are expected to quickly recolonize a disturbed area, while communities less adapted to frequent disturbance (e.g., attached fauna such as anemones and encrusting sponges associated with gravel, boulders, and cobble habitat noted in the northern portions of the ECCs) may take upwards of a year to begin recolonization (BERR, 2008; BOEM, 2013; Guarinello et al., 2017). Effects are expected to be temporary, short-term, and localized in the Lease Area and southern portions of the Falmouth and Brayton Point ECCs. In areas with complex habitat (i.e., northern portions of the ECCs), recolonization is expected to occur over a longer period of time (1 to 3 years) (BERR, 2008; BOEM, 2012; Guarinello et al. 2017; HDR, 2020). Foundations and scour protection/cable protection would create an artificial reef effect (Degraer et al. 2020), likely leading to enhanced biological productivity and increased abundance and concentration of fish and invertebrate resources (HDR 2020). However, while new structures could introduce hard substrate creating novel habitat for colonization, it could conversely facilitate the spread of invasive species, become predator traps, or disrupt migratory behavior in some species (Reubens et al. 2014, De Mesel et al. 2015, HDR 2020; as cited in Degraer et al. 2020).

Recent studies performed as part BOEM's Real-time Opportunity for Development Environmental Observations (RODEO) program collected three years of benthic habitat data from the Block Island Wind Farm to assess the temporal and spatial changes in substrate characterization and benthos abundance and distribution near the WTG foundations during operations. Epifaunal monitoring data was collected using video analysis and benthic grab sampling from two of the five WTGs at various distances from the WTG foundations. Results of the RODEO program found that by year 2 of epifaunal monitoring, the foundations were primarily colonized by dense blue mussel aggregations; approximately 61-88 percent of epifauna observed were blue mussels (HDR 2020). The epifaunal and sediment characteristics varied between WTGs and between survey years. Similar results may be expected during the operations phase of the proposed Project due to the close proximity of the Lease Area to the Block Island Wind Farm (located approximately 56.3 miles [90.6 kilometers] southeast of the Block Island Wind Farm).

Habitat conversion and loss could alter predator–prey interactions in and around the foundations and cable protection areas, with uncertain and potentially beneficial or adverse effects on ESA-listed species. For example, foraging loggerhead sea turtles, which are relatively common in the area, may benefit from increased biological productivity and abundant concentrations of prey (mollusks, crustaceans) generated by the reef effect (Russel et al. 2014). Conversely, the congregation of sea turtles around foundations may increase their susceptibility to predation as well as exposure to entanglement and vessel interaction due to increased recreational fishing within the wind farm (Barnette 2017).

Table 5.5-1. Area (acres) of different habitat types in the Project area

Habitat Types	Lease Area	Falmouth ECC Route – Federal	Falmouth ECC Route – MA State Waters	Brayton Point ECC Route – Federal	Brayton Point ECC Route – RI State Waters
Glacial Moraine A	-	-	1,691	411	185
Bedrock	-	-	-	-	3
Gravel Pavement	-	-	1,818	-	-
Mixed-Size Gravel	-	-	-	18	510
Boulder Fields Present	-	2.6	544	945	184
Coarse Sediment	-	-	2,325	1,026	0.1
Mud to Muddy Sand	49,731	15	444	4,015	3,851
Soft bottom sand	777	4,406	4,174	9,596	1,478
SAV	-	-	295	-	-
Shell accumulations	-	-	1,531	-	1,342
Anthropogenic	-	-	-	-	7
HAPC	-	151	10,895	0	6,210

ECC = export cable corridor; HAPC = habitat area of particular concern; MA = Massachusetts; RI = Rhode Island; SAV = submerged aquatic vegetation;

According to geophysical surveys along the Brayton Point ECC, sediment mobility along the corridor and risk to the cable is low. However, seabed preparation or alternate burial methods may be required in the northern portion of the Falmouth ECC in Muskeget Channel and Nantucket Sound, where surficial boulders, subsurface boulders, geological units representing hardgrounds or glacial tills, or shallowly buried channels with variable soil properties have been identified. The seabed preparation may include dredging or leveling steep and/or mobile seabed features to facilitate achieving the targeted depth of lowering to ensure adequate burial over the life of the Project. Additionally, dredging of cables may also be used for decommissioning of the Proposed Action.

The benthic area of impact from seafloor preparation activities and installation of WTG and OSP foundations are presented in Table 3.1-9. The area of impact from seafloor preparation activities and export cable installation is presented in Table 3.1-12, and include activities carried out by dredging. The anticipated volume of dredged material within the Falmouth ECC is approximately 646,077 cubic yards (493,962 cubic meters) while the anticipated volume of dredged material within the Brayton Point ECC is approximately 22,404 cubic yards (17,124 cubic meters). The area of disturbance from HDD activities are shown in Table 3.1-13.

As described in Section 3.1.2.4, it is anticipated that a pre-lay grapnel run will be completed along the entire length of each export cable route (along the anticipated centerline) within the ECCs, and along the entire length of each interarray cable route within the Lease Area, shortly before cable installation. A pre-lay grapnel run will be conducted to clear the cable route of buried hazards along the installation route to remove obstacles that could impact cable installation, such as abandoned mooring lines, wires, or derelict fishing gear. SouthCoast Wind will coordinate with relevant federal and state agencies in addition to SouthCoast Wind's other outreach efforts (i.e., direct outreach, outreach via Fisheries Representatives) to notify commercial and recreational fishermen prior to initiation of the pre-lay grapnel run.

5.5.2.1 WTGs/OSPs Foundations and Scour Protection

The installation of WTG and OSP foundations for the Proposed Action would result in the loss of soft-bottom habitat (the only habitat type in the Lease Area), including fine sand and silt/mud areas with little relief, in the foundation footprints as shown in Table 3.1-9.

The installation of 147 52.5-foot- (16-meter) diameter monopile foundations for the WTGs and 2 OSPs with piled jacket foundation types would render approximately 390 acres (158 hectares) of soft-bottom (fine sand and silt/mud) into hard bottom habitat for the 30-year life of the Project through decommissioning when the foundation and scour protection are to be removed (Table 3.1-9). For piled-jacket foundation WTGs, the equivalent estimated benthic habitat disturbance area is 403 acres (163 hectares). SouthCoast Wind is considering suction-bucket jackets for up to 85 WTG positions in the southern portion of the Lease Area. If suction-bucket jackets are used, maximum benthic habitat disturbance would be 598 acres (242 hectares) associated with 85 suction-bucket jackets WTGs, 62 piled jacket foundation WTGs, and 2 OSPs with piled jacket foundation types (which have the largest footprint of any OSP type and are considered the most likely type to be used by SouthCoast Wind). During decommissioning, foundations that required pile driving for installation (i.e., monopiles and piled jacket WTGs), will be cut at an approved depth within the subsurface and subsequently pulled out of the seabed. Suction-bucket foundations may require pumps to allow them to be more easily removed from their position suctioned to the seabed. Potential entrainment impacts on prey species from the installation of suction-bucket jacket foundations are discussed in Section 5.5.11.

The average water depth in the Lease Area is approximately 164 feet (50 meters). (COP Volume 2, SouthCoast Wind 2023) and the installation of vertical structures in the water column would introduce new hard surfaces extending from the seabed to the water surface. The resulting underwater vertical structure from any foundation type installed would alter the characteristics of pelagic habitats used by many EFH species and their prey and foraging resources. Though the installation of WTGs and OSPs would result in the loss of soft-bottom habitat, it would also result in the conversion of open-water habitat to hard, vertical habitat, which would attract and aggregate prey species through the artificial reef effect (Causon and Gill 2018; Taormina et al. 2018). Over time, these new hard surfaces will become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reef. In addition to reef effects, the WTGs may create localized hydrodynamic effects that could have localized effects on food web productivity and pelagic eggs and larvae. Hydrodynamic effects are described in Section 5.5.6.

5.5.2.1.1 Marine Mammals

The WTG and OSP foundations would introduce complex three-dimensional structures to the water column that could potentially alter the normal behavior of aquatic organisms in the Project area (see Section 5.5.6). Baleen whale species addressed in this consultation are pelagic filter feeders that do not forage in or rely on benthic habitats, although it is recognized that species such as fin whales periodically prey on forage fish such as herring that rely on complex benthic habitats. Sperm whales, on the other hand, are known to prey on bottom-oriented organisms including octopus, fish, shrimp, crab, and sharks, suggesting that short-term construction and installation disturbance could affect the prey base for this species. Similarly, fin and sei whales are known to forage on sand lance, which are strongly associated with sandy substrate. The installation of foundations could result in a loss of these soft bottom habitats, potentially causing a localized reduction in sand lance available for forage in the Project area. As such, the disturbance and modification of complex habitats could lead to subsequent effects on foraging opportunities for marine mammals that rely on these resources. However, observations of fish community response to the development of other offshore wind facilities suggest there is little basis to conclude that habitat disturbance and modification would lead to a measurable long-term adverse effect on the availability of fish and invertebrate prey organisms. For example, monitoring studies of the Block Island Wind Farm and other European wind energy (Hutchison et al. 2020a; Methratta and Dardick 2019; Guarinello and Carey 2022) have documented increased abundance of demersal fish species that also prey on forage fish, likely attracted by increased biological productivity created by the reef effect these structures generate. While seabed disturbance may result in changes in prey availability for some marine mammal species, these effects would be localized and unlikely to have a measurable effect on the ability of marine mammals to find suitable prey elsewhere within their seasonal range. These beneficial effects, however, have the potential to be offset by an increase in recreational fishing and the associated risks from gear entanglement and vessel interaction (Moore and van der Hoop 2012). Similarly, the introduction of new surfaces could also be colonized by invasive species that have the potential to cause widespread and permanent adverse effects if the species were to become established and out-compete native fauna or modify habitat (HDR 2020). As part of the Proposed Action, SouthCoast Wind will use HDD for sea-to-shore transitions (Section 3.1.2.4.3) to minimize sediment mobilization and reduce sediment disturbance during offshore component installation. Further, an agency-proposed measure (NS-2, Table 3.3-2) intends to minimize the overall structure impact to potential marine mammal benthic prey species by only installing monopile or piled jacket foundations within the enhanced mitigation area (Figure 3.3-1).

While seafloor disturbance and habitat modification may result in changes in prey availability for some marine mammal species, these effects would be short term and localized and unlikely to have a measurable effect (i.e., will be **insignificant)** on the ability of marine mammals to find suitable prey elsewhere within their seasonal range. Therefore, benthic habitat alteration due to the presence of foundations and scour protection **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.2.1.2 Sea Turtles

The disturbance and alteration of the seabed is unlikely to measurably affect ESA-listed sea turtles. Leatherback sea turtles are dietary specialists, feeding almost exclusively on pelagic jellyfish, salps, and siphonophores, meaning they would not be measurably affected by benthic habitat alteration. While green, Kemp’s ridley, and loggerhead sea turtles all feed on benthic organisms, short-term benthic habitat disturbances are unlikely to have measurable adverse effects on prey resources for these species. In the nearshore Falmouth area, sea-to-shore transition of cables at landfall will be made via HDD (Section 3.1.2.4.3) in order to avoid direct impacts to documented SAV beds dominated by eelgrass in the nearshore Falmouth area to minimize sediment disturbance during offshore component installation. This method would effectively reduce any adverse effects to forage resources for green, loggerhead, and Kemp's ridley sea turtles. The loss of soft-bottom habitat in the Action Area could potentially affect loggerhead and Kemp's ridley sea turtles that forage on crabs, mollusks, and other invertebrates associated with benthic habitats (NMFS and USFWS 2007c). However, the habitat loss would be small relative to similar habitat available in the Action Area. Therefore, habitat loss associated with WTGs and OSPs would have an insignificant effect on loggerhead and Kemp's ridley sea turtles. No effects of habitat loss are expected for other ESA-listed sea turtle species.

Aggregation of prey species at WTG and OSP foundations, such as crustaceans attracted to the artificial reef or encrusting bivalves, may benefit ESA-listed sea turtles through increased foraging opportunities. In the Gulf of Mexico, green, Kemp's ridley, leatherback, and loggerhead sea turtles have been documented in the presence of offshore oil and gas platforms (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976; Rosman et al. 1987), indicating that sea turtles are likely to use habitat created by in-water structures to forage. However, increased foraging opportunities are not expected to be biologically significant given the broad geographic range used by sea turtles on their annual foraging migrations compared to the localized scale of artificial reef effects for the Proposed Action. Further, these beneficial effects have the potential to be offset by an increase in recreational fishing and the associated risks from gear entanglement and vessel interaction (Moore and van der Hoop 2012). Similarly, the introduction of new surfaces could also be colonized by invasive species that have the potential to cause widespread and permanent adverse effects if the species were to become established and out-compete native fauna or modify habitat (HDR 2020).

Given that the affected area is naturally dynamic and exposed to anthropogenic disturbance, the species that occur in this region presumably adjust foraging behavior based on prey availability. Kemp's ridley and green sea turtles are omnivorous species with flexible diets, and loggerhead sea turtles readily target new prey species to adapt to changing conditions. Given the limited amount of foraging habitat exposed to construction and installation disturbance, the short-term nature of these effects, the ability of these species to adjust their diet in response to resource availability, and the implementation of mitigation measures to reduce such impacts, any effects from habitat conversion due to WTGs/OSPs or scour protection are expected to be so small that they cannot be meaningfully measured, evaluated or detected, so are **insignificant**, and benthic habitat alteration due to the presence of foundations and scour protection **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.2.1.3 Fish

Installation of WTGs, OSPs, and scour protection would transform potential soft bottom foraging habitat for Atlantic sturgeon into coarse, hard-bottom habitat through placement of monopiles and jacketed piles, scour protection, and cable protection (see Table 3.1-9 for seabed disturbance and scour protection amount by foundation type); such changes will persist through the O&M phase. The addition of the WTGs and OSPs is expected to result in long-term habitat alteration in the area immediately surrounding each foundation from a soft sediment, open-water habitat system to a structure-oriented system, including an increase in fouling organisms. Over time (weeks to months), the areas with scour protection are likely to be colonized by sessile or mobile organisms (e.g., sponges, hydroids, and crustaceans). This results in a modification of the benthic community in these areas from primarily infaunal organisms (e.g., amphipods, polychaetes, and bivalves). Hard-bottom habitat 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 (Taormina et al. 2018), which may provide a potential increase in available forage items for Atlantic sturgeon compared to the surrounding soft-bottom habitat. Studies have demonstrated that WTG foundations and scour protection acted as artificial reefs with high species diversity and abundance of epibenthic species, comparable to that of a natural rocky reef (Coolen et al. 2018). However, these beneficial effects have the potential to be offset by an increase in recreational fishing and the associated risks from gear entanglement and vessel interaction (Moore and van der Hoop 2012). Similarly, the introduction of new surfaces could also be colonized by invasive species that have the potential to cause widespread and permanent adverse effects if the species were to become established and out-compete native fauna or modify habitat (HDR 2020).

Atlantic sturgeon may also experience a reduction in infaunal benthic organisms, such as polychaete worms, in areas where soft substrate is lost or converted to hard substrate. The only forage fish anticipated to be impacted by these habitat alterations would be sand lance, as they are the most dependent on soft bottom habitat among forage fish species (Staudinger et al. 2020). As sand lance are strongly associated with sandy substrate, and the Proposed Action 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, considering the size of the Action Area, which is dominated by sandy substrate (Table 5.5-1), the loss or conversion of soft-bottom habitat would be very small compared to the available habitat area. Is expected that due to the highly mobile behavior of the Atlantic sturgeon, the large foraging areas over which Atlantic sturgeon search and forage for food (Smith et al. 1985; Johnson et al. 1997; Dadswell 2006), the opportunistic nature of the Atlantic sturgeon diet (Smith 1985), and the relatively small area of habitat conversion compared to the wider continental shelf, the effects of long-term habitat conversion from soft to hard bottom habitat is expected to be so small that it cannot be meaningfully measured, evaluated or detected , and is thus **insignificant**. Any impacts due to sediment disturbance or alteration would be further minimized as SouthCoast Wind intends to use HDD for sea-to-shore transitions (Section 3.1.2.4.3) to minimize sediment mobilization during offshore component installation. Further, an agency-proposed measure (NS-2, Table 3.3-2) intends to minimize the overall structure impact to potential Atlantic sturgeon benthic prey species by only installing monopile or piled jacket foundations within the enhanced mitigation area (Figure 3.3-1). Therefore, benthic habitat alteration due to the presence of foundations and scour protection **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.2.2 Cable Emplacement/Maintenance

The Proposed Action would install interarray cables in the Lease Area and export cables within the Falmouth and Brayton Point ECCs, as described in Section 3.1.2.4. For the Brayton Point ECC where sea-to-shore transition activities (HDD) would occur, the two cable bundles will split into up to four HDD exit pits at each of three landfall locations: south of Aquidneck Island, north of Aquidneck Island, at Brayton Point. The Falmouth landfall location would also have four HDD exit pits. At each landfall option, the four HDD exit pits would be arranged in a cluster; maximum potential area of impact described in the subsections below includes potential temporary disturbances inclusive of exit pit, cofferdam, and support vessels.

The below analysis on areas of impact to benthic habitats is based on information from COP Appendix M.3 (SouthCoast Wind 2023), which was compiled to assess impacts to EFH based on heterogenous habitat types encountered in the ECCs relative to the homogenous soft-bottom habitat of the Lease Area. Potential areas of sand wave clearance and boulder removal in the ECCs are shown in Figure 3.1-9.

Sand Wave Clearance

Sand wave clearance over approximately five percent of the Falmouth ECC is expected, primarily in Muskeget Channel and Nantucket Sound. Portions of the Falmouth ECC where sand waves were mapped may require sand wave removal where micro-siting of the cables cannot avoid these features. Up to 429 acres (174 hectares) may be temporarily impacted by sand wave removal. The potential impacted habitat includes 52 acres (21 hectares) of large grained complex habitat, 140 acres (57 hectares) of complex habitat, and 237 acres (96 hectares) of soft bottom habitat.

Boulder Removal

Boulder removal and/or clearance will occur where boulders are present and cannot be avoided with micro-siting. For the Lease Area, boulder field removal is not expected. Portions of both the Brayton Point ECC and Falmouth ECC where boulders were mapped may require boulder removal (by grab) or clearance (by plow), where micro-siting of the cable bundles cannot avoid these boulders. The boulder grab will be used to the extent possible, and the use of the 49-foot-wide (15 meters) boulder plow will be minimized.

In the Brayton Point ECC, up to 1,135 acres (459 hectares) may be temporarily impacted by boulder removal. Habitat types potentially impacted include 4 acres (1.4 hectares) of anthropogenic habitat, 31 acres (13 hectares) of large grained complex habitat, 150 acres (61 hectares) of complex habitat, 56 acres (23 hectares) of heterogeneous complex habitat, and 894 acres (362 hectares) of soft bottom habitat.

In the Falmouth ECC, up to 498 acres (202 hectares) may be temporarily impacted by boulder removal. Potential habitats impacted include 144 acres (58 hectares) of large-grained complex habitat, 220 acres (89 hectares) of complex habitat, 17 acres (7 hectares) of heterogenous habitat, and 117 acres (47 hectares) of soft bottom habitat.

Pre-lay Grapnel Run and Cable Installation

A pre-lay grapnel run is expected to occur over the entirety of both ECCs and the interarray cable locations to remove any remaining obstructions prior to cable installation. Temporary disturbance related to installation of the interarray cable is anticipated along the entire length of the interarray network. Cable installation across the entire interarray network would temporarily impact a total of ~191 to 1,081 acres (77 to 438 hectares), which does not include the ~71 acres (29 hectares) of temporary seafloor disturbance surrounding each of the 149 foundation locations. Only soft-bottom habitat types would be impacted in the Lease Area.

Temporary disturbance related to installation of the Brayton Point cables is anticipated along the entire length of the Brayton Point ECC and would impact a total estimated area of 453.8 acres (183.6 hectares) that could potentially reach a maximum range of ~463 to 593 acres (187.4 to 240 hectares). Habitat types potentially impacted include 1.5 acres (0.6 hectares) of anthropogenic habitat, 13 acres (5 hectares) of large-grained habitat, 60 acres (24 hectares) of complex habitat, 22 acres (9 hectares) of heterogeneous complex habitat, and 358 acres (145 hectares) of soft bottom habitat.

Temporary disturbance related to installation of the Falmouth cables are anticipated along the entire length of the Falmouth ECC and would impact up to 1,038 acres (420 hectares). Habitat types potentially impacted include 58 acres (23 hectares) of large grained complex habitat, 163 acres (66 hectares) of complex habitat, 7 acres (3 hectares) of heterogeneous complex, and 405 acres (164 hectares) of soft bottom habitat.

Cable installation tools for all cables would measure up to ~20 feet (6 meters) wide for all cable installation. To minimize the impacts of habitat conversion and seabed disturbance to ESA-listed species, SouthCoast Wind intends to bury submarine cables at depths between 3 to 8 feet (1 to 2.5 meters) for inter-array cables and between 3 to 13 feet (1 to 4 meters) for export cables.

Cable Protection

The majority of the habitat impacted by interarray and export cable installation and seabed preparation are expected to return to pre-construction baseline conditions when the target burial is achieved. When cable burial cannot be achieved, cable protection will be installed. For the Proposed Action, the installation of cable protection for the Falmouth export cables would result in habitat conversion and loss for 62 to

104 acres (24 to 42 hectares) for up to 5 export cables. Potential habitat types impacted would be 58 acres (23 hectares) of large grained complex habitat, 163 acres (66 hectares) of complex habitat, 7 acres (3 hectares) of heterogeneous complex habitat, and 405 acres (164 hectares) of soft bottom habitat type. The installation of cable protection for the Brayton Point export cable would result in habitat conversion and loss for 68 acres (28 hectares) to 89 acres (28 to 36 hectares) for up to 2 cable bundles for Brayton Point. Habitat types potentially impacted include 1.5 acres (0.6 hectares) of anthropogenic habitat, 13 acres (5 hectares) of large grained complex habitat, 60 acres (24 hectares) of complex habitat, 22 acres (9 hectares) of heterogeneous complex habitat, and 358 acres (145 hectares) of soft bottom habitat. For the interarray cables, 26 to 115 acres (11 to 47 hectares) may be subject to cable protection measures. In the Lease Area, any area that requires cable protection would convert soft bottom habitat to hard bottom habitat. Variable amounts of conversion are expected in the ECCs, as some areas that require cable protection would be hard bottom habitat types and others may be soft bottom habitat types (i.e., mixed habitat types in Falmouth ECC). Cable protection may attract and aggregate prey species through artificial reef effect (Causon and Gill 2018; Taormina et al. 2018).

HDD Exit Pits

Disturbance impacts from HDD exit pits are identified in Table 3.1-13. For Aquidneck Island intermediate landfalls, all potential impacts at these landfall options are located entirely in habitats cross-walked to the NOAA Complexity Category of complex due to the presence of *Crepidula* Substrate, with the exception of the Roger Williams University landfall which was classified as 70 percent complex and 30 percent soft bottom. At the Brayton Point landfalls, the total area of disturbance for the Taunton River (Western) landing is 0.3 acres (0.12 hectares) as this landfall is located within a dredged material deposit. Alternatively, 0.24 acres (0.09 hectares) of soft bottom would be the maximum potential impact at the Lee River (Eastern) landfall. The total maximum potential area of temporary impact would be 0.4 acres (0.16 hectares) for the Falmouth landfall. The three landfall locations for Falmouth all occur within soft-bottom habitats. The HDD cable installation plan would avoid direct impacts to documented SAV near the Falmouth landfall.

5.5.2.2.1 Marine Mammals

The habitat conversion and loss effects associated with cable emplacement and maintenance activities for the Proposed Action on ESA-listed marine mammals is expected to be similar to the effect of habitat conversion associated with WTGs and OSPs and scour protection, but greatly reduced in scope (Section 5.5.2.1). There would be very limited impacts on the water column during the O&M phase from conversion to hard bottom habitat from cable protection in the form of rock berms and concrete mattresses. Reef effects may be expected where cable protection is present and wherever boulders are relocated. Some areas where cables cannot be buried would be hard bottom habitat already, thus the addition of cable protection would not remarkably change the sediment type. Sand wave clearance is only expected for five percent of the Falmouth ECC and impacts on forage fish would be similar to Section 5.5.2.1.3. The habitat impacts from a pre-lay grapnel run are unlikely to impact marine mammals or the species they feed upon relative to the area available for forage for prey species and marine mammals.

The only permanent effects of cable emplacement expected are from cable protection and sand wave clearance, all other impacts due to habitat conversion and loss are expected to be temporary. Further, SouthCoast Wind will use HDD for sea-to-shore transition (Section 3.1.2.4.3) to minimize sediment mobilization and seabed sediment alteration for cable burial operations. To effectively assess the impacts to benthic habitats, BOEM will require the Lessee to conduct Benthic Habitat Surveys of at a minimum, one year during pre-construction, one year during construction, and two years post-construction (BA-3, Table 3.3-2).

Given the small scale of anticipated effects and the application of mitigation and monitoring measures to minimize such effects, any effects on habitat conversion and loss due to cable emplacement or maintenance are expected to be so small that they cannot be meaningfully measured, evaluated or detected and are therefore **insignificant.** Cable emplacement and maintenance **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.2.2.2 Sea Turtles

The effect of habitat conversion associated with cable emplacement and maintenance for the Proposed Action on ESA-listed sea turtles is expected to be similar to the effect of habitat conversion associated with WTGs and OSPs and scour protection, but greatly reduced in scope (Section 5.5.2.1). There would be very limited impacts on the water column during the O&M phase from conversion to hard bottom habitat from cable protection in the form of rock berms and concrete mattresses. Reef effects may be expected where cable protection is present and wherever boulders are relocated. Some areas where cables cannot be buried would be hard bottom habitats thus the addition of cable protection would not remarkably change the sediment type. Sand wave clearance is only expected for 5 percent of the Falmouth ECC and impacts on forage fish would be similar to Section 5.5.2.1.3. The only permanent effects of cable emplacement expected are from cable protection and sand wave clearance, all other impacts due to habitat conversion and loss are expected to be temporary. Further, SouthCoast Wind will use HDD sea-to-shore transition to minimize sediment mobilization and seabed sediment alteration for cable burial operations. To effectively assess the impacts to benthic habitats, BOEM will require the Lessee to conduct Benthic Habitat Surveys of at a minimum, 1 year during pre-construction, 1 year during construction, and 2 years post-construction (BA-3, Table 3.3-2).

Given the small scale of anticipated effects and the application of mitigation and monitoring measures to minimize such effects, any effects from habitat conversion due to cable emplacement or maintenance are expected to be so small that they cannot be meaningfully measured, evaluated or detected, so are **insignificant**, and thus **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.2.2.3 Fish

The effect of habitat conversion associated with cable emplacement and maintenance for the Proposed Action on Atlantic sturgeon is expected to be similar to the effect of habitat conversion associated with WTGs and OSPs and scour protection, but greatly reduced in scope (Section 5.5.2.1). There would be very limited impacts on the water column during the O&M phase from conversion to hard bottom habitat from cable protection in the form of rock berms and concrete mattresses. Reef effects may be expected where cable protection is present and wherever boulders are relocated. As larger Atlantic sturgeons have a strong preference for polychaete worms, the conversion or loss of soft substrate in certain areas may lead to a decrease in the availability of these infaunal benthic organisms for foraging. Some areas where cables cannot be buried would be hard bottom habitats thus the addition of cable protection would not change the sediment type greatly. Sand wave clearance is only expected for 5 percent of the Falmouth ECC and impacts on forage fish would be similar to Section 5.5.2.1.3. The only permanent effects of cable emplacement expected are from cable protection and sand wave clearance, all other impacts due to habitat conversion and loss are expected to be temporary. To minimize the effects of habitat conversion due to cable emplacement and maintenance, SouthCoast Wind will use HDD sea-to-shore transitions HDD (Section 3.1.2.4.3) to reduce the dredging footprint and minimize sediment mobilization and seabed sediment alteration. To effectively assess the impacts to benthic habitats, BOEM will require the Lessee to conduct Benthic Habitat Surveys of at a minimum, 1 year during pre-construction, 1 year during construction, and 2 years post-construction (BA-3, Table 3.3-2).

Given the small scale of anticipated effects and the application of mitigation and monitoring measures to minimize such effects, the effects of habitat conversion due to cable emplacement or maintenance are expected to be so small that they cannot be meaningfully measured, evaluated or detected, so are **insignificant**, and thus **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.2.3 Spuds/Anchors

Dynamic positioning (DP) vessels will generally be used for cable burial activities; within segments of the ECCs where anchoring has been identified as a potential option, anchoring using moored spreads may be used. Anchoring is more likely to occur within soft bottom habitats. Vessels required for the construction phase of the Proposed Action could anchor at various locations throughout the offshore ECCs (Figure 3.1-10 and Figure 3.1-11). Anchoring, including anchor chain sweep, will result in shallow drags in seafloor sediment. Jack-up vessels and heavy-lift barges will also disturb the seafloor within the footprint of the spuds during foundation installation. Disturbances will vary in magnitude as a result of several factors including: wave and current conditions, anchor size, seafloor characteristics at the anchoring site, and vessel drag distances.

Vessel anchoring during construction of the Proposed Action may temporarily disturb approximately 442 acres (179 hectares) of benthic habitat in the Lease Area at WTG positions and in the ECCs but is not expected to result in significant habitat loss or conversion in the Action Area as each anchor is estimated to be only ~16 feet (5 meters) in diameter. Although up to 203 anchor points could be used in the Brayton Point corridor, anchors will be spaced every 886 feet (270 meters) totaling < 1 acre (0.4 hectares) of impact in largely soft-bottom habitats. This equates to 1 to 5 acres of temporary impact, to allow for length differences related to the full PDE, in the Brayton Point ECC over mostly soft-bottom habitat. In the Falmouth ECC, 211 anchor point would be spaced every 886 feet (270 meters) for a total of 1 acre (0.4 hectares) of impact; however, similar to the Brayton Point ECC, a conservative estimate of 1 to 5 acres of impact is anticipated. Anchoring in the Falmouth ECC would occur in both soft-bottom habitats and heterogenous complex habitats.

Vessel anchoring may result in temporary disturbance of bottom sediments during export cable installations. Temporary, short-term, direct effects associated with vessel anchoring include mortality or injury of slow-moving or sessile species within the affected area from spuds, vessel anchor, or anchor chain. The extent of the effects will vary based on vessel type, number, and duration. The footprint of the jack-up vessel spuds on the seafloor is estimated at 0.37 acres (0.15 hectares) per jack-up vessel (including all jack-up legs). During installation, there may be six to eight vessel visits for the WTG locations and four visits to OSPs.

Seabed disturbance from vessel anchoring during the decommissioning phase is anticipated to be of the same magnitude as the construction phase when similar vessels are required.

5.5.2.3.1 Marine Mammals

The effect of habitat conversion and loss associated with spuds/anchoring for the Proposed Action on ESA-listed marine mammals is relatively small compared to WTGs/OSPs foundation and scour protection and cable presence/protection. The 442 acres (179 hectares) impacted by spuds/anchoring is spread over the entire Project area. This means small, dispersed areas of benthic habitat will be impacted over the course of construction. Similarly, there would be increased vessel anchoring during the construction phase that would cause short-term and localized increases in turbidity levels (further discussed in Section 5.5.3). Benthic habitats are expected to recover from far more invasive installation activities than anchoring; thus, it is not expected that benthic habitats temporarily impacted by anchoring would result in long-term habitat conversion or loss. In addition, SouthCoast Wind would use DP vessels (Section 3.1.2.6) when practical and safe in order to reduce the total area impacted by anchoring.

Given this small, localized, and temporary reduction in benthic habitat due to vessel anchoring and with the implementation of mitigation measures to reduce such impacts, any effects are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and is therefore **insignificant**. Habitat conversion and loss due to spuds/anchors **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.2.3.2 Sea Turtles

The effect of habitat conversion and loss associated with anchoring/spuds for the Proposed Action on ESA-listed sea turtles is relatively small compared to WTGs/OSPs foundation and scour protection and cable presence/protection. The 442 acres (179 hectares) impacted by spuds/anchoring is spread over the entire Project area. During the construction phase, an increase in vessel anchoring is expected, which would cause short-term and localized increases in turbidity levels (further discussed in Section 5.5.3). Benthic habitats are expected to recover from more invasive installation activities than anchoring; thus, it is not expected that benthic habitats temporarily impacted by anchoring would result in long-term habitat conversion or loss. In addition, SouthCoast Wind would use DP vessels (Section 3.1.2.6) when practical and safe in order to reduce the total area impacted by anchoring.

Given this small, localized, and temporary reduction in benthic habitat due to vessel anchoring and with the implementation of mitigation measures to reduce such impacts, any effects are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and is therefore **insignificant**. Habitat conversion and loss due to spuds/anchors **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.2.3.3 Fish

The effect of habitat conversion associated with mats/anchoring for the Proposed Action on ESA-listed fish species is relatively small compared to WTGs/OSPs foundation and scour protection and cable presence/protection. The 442 acres (179 hectares) impacted by spuds/anchoring is spread over the entire Project area. This means small, dispersed areas of benthic habitat will be impacted over the course of construction. Similarly, there would be increased vessel anchoring during the construction phase that would cause short-term and localized increases in turbidity levels (further discussed in Section 5.5.3). Benthic habitats are expected to recover from far more deleterious impacts than anchoring; thus, it is not expected that benthic habitats temporarily impacted by anchoring would result in long-term habitat conversion or loss. In addition, SouthCoast Wind would use DP vessels (Section 3.1.2.6) when practical and safe in order to reduce the total area impacted by anchoring.

Given this small, localized, and temporary reduction in benthic habitat due to vessel anchoring and with the implementation of mitigation measures to reduce such impacts, any effects are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and is therefore **insignificant**. Habitat conversion and loss due to spuds/anchors **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.3 Turbidity

Construction activities with the potential to disturb bottom sediments include vessel anchoring (including spuds), foundation and scour protection installation, installation of WTG, OSP, interarray, export, and sea-to-shore transition cables and any seafloor preparation activities. These activities would disturb bottom sediment, resulting in short-term increases in turbidity in the Action Area.

Using available information collected from a project in the Hudson River, pile driving activities are expected to produce total suspended sediment (TSS) concentrations of approximately 5.0 to 10.0 mg/L above background levels within approximately 300 feet (91 meters) of the pile being driven (NMFS

2020a citing FHWA 2012). The increases in suspended sediment associated with pile driving would be localized to the vicinity of the pile being driven.

During cable installation, jet plowing is expected to produce maximum TSS concentrations of approximately 235 mg/L at 65 feet (20 meters) from the jet plow, with concentrations decreasing to 43 mg/L within 656 feet (200 meters) (NMFS 2020a citing ESS Group 2008). Further, jet plowing typically releases more turbidity than mechanical methods and is considered the worst-case installation method for this effects analysis. Sediment transport analysis conducted for the Proposed Action predicted that redeposition of suspended sediments occurs quickly before being transported long distances. Total suspended solid concentrations above 100 milligrams per liter (mg/L) (0.0008 pounds per gallon) extended a maximum of 1,214 feet (370 meters) for any scenario except for nearshore areas of the Brayton Point corridor, where they extended to just over 0.6 mile (1 kilometer). The maximum total suspended solid level dropped below 10 mg/L (0.00008 pounds per gallon) within 2 hours for all simulated scenarios and dropped below 1 mg/L (0.000008 pounds per gallon) within 4 hours for any scenario except for nearshore areas of the Brayton Point corridor, where 200 mg/L and 10 mg/L concentrations lasted for longer than about 2 hours and a several hours after re-suspension, respectively. Deposition thicknesses exceeding 0.2 inches (5 millimeters) were generally limited to a corridor with a maximum width of 79 feet (24 meters) around the cable routes but reached a maximum of 590 feet (180 meters) from the centerline for the interarray cables (COP Appendices F1 and F3; SouthCoast Wind 2023).

Modeling results of suction dredging for the HDD exit pit indicate that elevated TSS levels will impact a limited area. For both neap and spring tides sediment concentrations exceeding 10 mg/L (0.00008 pounds per gallon) are found at a maximum distance of 755 feet (230 meter) and 492 feet (150 meters), the impacted areas are respectively 4.2 acres (1.7 hectares) and 3.7 acres (1.5 hectares). Similarly, deposited sediments exceeding 0.2 inch (5 millimeter) thickness for the neap and spring tides are expected to occur 85 feet (26 meters) and 105 feet (32 meters) from the HDD exit location. Given the static nature of dredging at the HDD exit pit, sediment deposition is expected to be greater than deposition from jet plowing for cable installation.

Routine maintenance activities during Project operation, as described in Section 3.1.2.4, could result in short-term increases in turbidity in the Action Area. Any increases in TSS concentrations would occur in the Project area and are not expected to exceed background levels associated with natural events (Appendix F1, SouthCoast Wind 2023). To further minimize any impacts from turbidity to ESA-listed species, SouthCoast Wind will use DP vessels and HDD for sea-to-shore transition (Sections 3.1.2.6 and 3.1.2.4.3), which would minimize sediment mobilization and sediment seabed alteration during offshore component installation and during cable burial operations.

Decommissioning activities would include removal and/or decommissioning of all Proposed Action infrastructure and clearance of the seabed of all obstructions at the end of the Proposed Action’s designed service life, as described in Section 3.1.2.9. Some activities would result in bottom disturbance, resulting in short-term increase in turbidity in the Action Area. Impacts during decommissioning, including turbidity impacts, are expected to be similar or less than those experienced during construction (Appendix F1, SouthCoast Wind 2023).

5.5.3.1 Marine Mammals

As marine mammals may occur within the portion of the Action Area affected by pile driving, cable laying, and dredging during construction, as well as O&M and decommissioning activities, increased turbidity associated with the Proposed Action could potentially affect these species. There are no data on the physiological effects of suspended sediment on whales. Elevated suspended sediment may cause these species to alter their normal movements but such alterations are expected to be too small to be meaningfully measured or detected (Johnson 2018; Todd et al. 2015). No effects are anticipated if whales swim through the area of elevated suspended sediment. Suspended sediment is most likely to impact whales if the area of elevated concentrations acts as a barrier to normal behaviors. However, whales are expected to swim through sediment plumes or avoid the area of increased turbidity with no adverse effects. If elevated turbidity causes any behavioral responses, such responses would be temporary and **insignificant** (Todd et al. 2015).

Sediment plumes associated with Project activities would be localized and short term. The plumes generated by pile driving are expected to extend up to 300 feet (91 meters), based on modeling done in the Hudson River. Sediment dispersion modeling done for the SouthCoast Wind ECC and inter-array cable routes indicated that plumes generated from the cable installation activities with concentrations exceeding 50 mg/L would be limited to the first 16 feet (5 meters) above the seabed. Sediment plumes with concentrations above 100 mg/L (0.0008 lb/gal) would be expected to extend to a maximum of 1,214 feet (370 meters) horizontally from the corridor centerline and affect a cumulative area of 4,569 acres (1,849 hectares) for the entirety of the offshore export cable corridors and inter-array cable routes. Turbidity levels associated with the HDD exit pit dredging are significantly smaller compared with the impact resulting from the cable trenching/dredging, with concentrations exceeding 100 mg/L (0.0008 lb/gal) found at a maximum distance of 118 feet (36 meters). Potential plumes would generally remain suspended for two hours before the maximum TSS levels drop to 10 mg/L (0.00008 lb/gal) and below 1 mg/L (0.000008 lb/gal) after less than four hours. Given the short duration and limited spatial scale of the sediment plumes relative to the size of the Action Area, increased suspended sediment concentrations associated with Project activities are not expected to obstruct the movement of marine mammals in the Action Area.

As described in Johnson (2018), NMFS has determined that elevated TSS could result in effects on listed whale species under specific circumstances (e.g., high TSS levels over long periods during dredging operations). In general, marine mammals are not subject to impact mechanisms that injure fish (e.g., gill clogging, smothering of eggs and larvae), so injury-level effects are unlikely. Behavioral impacts, including avoidance or changes in behavior, increased stress, and temporary loss of foraging opportunity, could occur but only at high TSS levels (Johnson 2018). Todd et al. (2015) postulated that dredging and related turbidity impacts could affect the prey base for marine mammals, but the significance of those effects would be highly dependent on site-specific factors. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, these behaviors would be temporary, and any negative impacts would be short term. Cronin et al. (2017) suggest that NARWs may use vision to find copepod aggregations, particularly if they locate prey concentrations by looking upwards. However, Fasick et al. (2017) indicate that NARWs 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 greater than 525 feet [160 meters] or at night). If turbidity from cable installation caused foraging whales to leave the area, there would be an energetic cost of swimming out of the turbid area. However, whales could resume foraging behavior once they were outside of the turbidity zone. Recent studies indicate that whales are likely able to forage in low visibility conditions, and thus could continue to feed in elevated turbidity (Todd et al. 2015). Given that presence of ESA-listed marine mammals is greatest in offshore areas that may experience up to 100 mg/L TSS concentrations in areas near the cable centerline for a maximum of 2 hours, the relatively small-scale and short-term changes from construction and decommissioning activities that increase turbidity (e.g., interarray and export cable installation and vessel anchoring) are not likely to have measurable effects on ESA-listed whales and is **insignificant**.

NARWs feed almost exclusively on copepods. Of the different kinds of copepods, NARWs feed especially on late-stage *Calanus finmarchicus*, a large calanoid copepod (Baumgartner et al. 2007), as well as on *Pseudocalanus* spp. And *Centropages* spp. Copepods (Pace and Merrick 2008). Because a right whale’s mass is 10 or 11 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). Sei whales also feed on copepods; 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.

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). Baumgartner et al. (2011) conclude 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, no burial or loss of copepods is anticipated during installation of the cable. No scientific literature could be identified that evaluated the effects on marine copepods resulting from exposure to TSS. Based on what is known about effects of TSS on other aquatic life, it is possible that high concentrations of TSS could negatively affect copepods. However, given that 1) the expected TSS levels are below those that are expected to result in effects on even the most sensitive species evaluated; 2) the sediment plume would be transient and temporary (i.e., persisting in any one area for no more than 3 hours); 3) elevated TSS is limited to the bottom 16 feet (5 meters) of the water column; and 4) elevated TSS plumes would occupy only a small portion of the Action Area at any given time, any effects on copepod availability, distribution, or abundance on foraging whales would be so small that they could not be meaningfully evaluated, measured, or detected.

Fin whales in the North Atlantic eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lance. 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. Sperm whales hunt for food during deep dives, with feeding occurring at depths of 1,640 to 3281 feet (500 to 1,000 meters) (NMFS 2010). Deepwater squid make up the majority of their diet (NMFS 2010). Given the shallow depths of the Project area where sedimentation would occur, it is extremely unlikely that any sperm whales would be foraging in the area affected by sedimentation and extremely unlikely that any potential sperm whale prey would be affected by sedimentation.

As discussed above, elevated TSS would 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. In general, fish can tolerate at least short-term exposure to high levels of TSS. Wilber and Clarke (2001) reviewed available information on the effects of exposure of estuarine fish and shellfish to suspended sediment. In an assessment of available information on sublethal effects on non-salmonids, they report that the lowest observed concentration-duration combination eliciting a sublethal response in white perch (*Morone americana*) was 650 mg/L for 5 days, which increased blood hematocrit (Sherk et al. 1974, in Wilber and Clarke 2001). Regarding lethal effects, Atlantic silversides (*Menidia menidia*) and white perch were among the estuarine fish with the most sensitive lethal responses to suspended sediment exposures, exhibiting 10 percent 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 would 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, no mortality of any forage fish is expected; therefore, no reduction in fish as prey for fin or sei whales is anticipated.

Given the anticipated non-detectable changes in marine mammal movements and the use of DP vessels and HDD for sea-to-shore transition to minimize sediment disturbance (Sections 3.1.2.6 and 3.1.2.4.3), any effects from elevated turbidity and sediment deposition associated with the Proposed Action would be too small to be meaningfully measured, detected, or evaluated and is considered **insignificant**. Therefore, the effects of increased turbidity levels from Project construction activities **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.3.2 Sea Turtles

As sea turtles may occur within portions of the Action Area affected by pile driving, cable laying, and dredging during construction, as well as O&M and decommissioning activities, increased turbidity associated with Project activities could potentially affect these species. There are no data on the physiological effects of total suspended sediment on juvenile and adult sea turtles. While the increase in suspended sediments may cause sea turtles to alter their normal movements, these minor alterations in movements and behaviors would be too small to be meaningfully measured or detected (NMFS 2020a). Sea turtles breathe air and would be able to swim through the turbidity plume without adverse effects from passing through the area. Suspended sediment is most likely to impact sea turtles if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to sea turtles swimming through the area of elevated suspended sediment or avoiding the area (NMFS 2020a). In addition to direct effects on sea turtle behavior, suspended sediment can indirectly affect sea turtles through impacts on prey species, including benthic mollusks, crustaceans, sponges, and sea pens. Elevated suspended sediment concentrations are shown to have adverse effects on benthic communities when they exceed 390 mg/L (NMFS 2020a citing USEPA 1986). The maximum suspended sediment concentrations associated with pile driving (5 – 10 mg/L) and jet plowing (235 mg/L) are below the threshold that could have negative impacts on benthic communities (390 mg/L). Thus, water column turbidity should have no effect on benthic communities.

As described in Section 5.5.3, the suspended sediment plumes associated with Project activities would be localized and short term. The maximum sediment plume radius generated by the Proposed Action would be 3,280 feet (1,000 meters), associated with jet plowing in nearshore areas. Given the limited spatial scale of the sediment plumes relative to the size of the Action Area, increased suspended sediment concentrations associated with Project activities are not expected to obstruct the movement of sea turtles in the Action Area.

Increased deposition of suspended sediments during construction and decommissioning could impact the benthic prey/forage species of sea turtles, including SAV. The maximum deposition thickness (0.4 inch [1 millimeter]) would mostly be limited to an area 100 – 115 feet (30 – 35 meters) from the cable centerline; in areas where there are finer grain sediments, the maximum deposition thickness could increase locally up to 540 feet (165 meters) from the ECC cable centerline. It is anticipated there would be a short-term impact on the availability of prey species within the area of direct impact; however, it is anticipated that this area would be recolonized within a short period of time after the completion of cable installation activities. Because habitat disturbance would affect a relatively small amount of the Action Area and because of the short-term nature of the disturbance, the Project is expected to result in negligible reductions in benthic shellfish and infaunal organisms that serve as prey for ESA-listed species (NMFS 2020a), including sea turtles.

Given the anticipated non-detectable changes in sea turtle movements, the negligible reductions in prey species, and the use of DP vessels and HDD for sea-to-shore transition to minimize sediment disturbance, the effects of elevated turbidity and sediment deposition associated with the Proposed Action would be too small to be meaningfully measured, detected, or evaluated and is considered **insignificant.** Therefore, the effects of increased turbidity and deposition levels from Project construction activities **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.3.3 Fish

As ESA-listed fish species may occur within portions of the Action Area affected by pile driving, cable laying, and dredging during construction, as well as O&M and decommissioning activities, increased turbidity associated with Proposed Action activities could potentially affect this species. Studies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of milligrams per liter before an acute toxic reaction is expected (NMFS 2020a citing Burton 1993). TSS levels shown to have adverse effects on fish are typically above 1,000 mg/L (see summary of scientific literature in Burton 1993; Wilber and Clarke 2001). Potential physiological effects of suspended sediment on fish include gill clogging and increased stress (NMFS 2017). High TSS levels can cause a reduction in dissolved oxygen (DO) levels, and fish species such as the ESA-listed Atlantic sturgeon may become stressed when DO falls below certain levels (NMFS 2020a).

Increased turbidity can also result in behavioral effects in fish, such as foraging interference or inhibition of movement (NMFS 2017). However, increased turbidity is not expected to impact the ability of Atlantic sturgeon to forage as they are not visual foragers. Instead, Atlantic sturgeon rely on their barbels to detect prey and are known to forage during nighttime hours (NMFS 2017). Suspended sediment concentrations below thresholds for physiological impacts are not expected to inhibit sturgeon movement (NMFS 2017). While the increase in turbidity associated with the Proposed Action may cause Atlantic sturgeon to alter their normal movements, these minor alterations would be too small to be meaningfully measured or detected and are thus **insignificant**. TSS is most likely to affect sturgeon if a plume causes a barrier to normal behaviors. However, Atlantic sturgeon are expected to swim through the plume and otherwise avoid the area with no adverse effects (NMFS 2020a). Increased suspended sediment concentrations could also affect Atlantic sturgeon indirectly by affecting benthic prey species. TSS levels are shown to have adverse effects on benthic communities when they exceed 390.0 mg/L (NMFS 2020a citing USEPA 1986).

As described in Section 5.5.3, the suspended sediment plumes associated with Project activities would be localized and short term. The maximum sediment plume radius generated by the Proposed Action would be 3,280 feet (1,000 meters), associated with jet plowing in high current areas. Given the limited spatial scale of the sediment plumes relative to the size of the Action Area, increased suspended sediment concentrations associated with Project activities are not expected to obstruct the movement of Atlantic sturgeon in the Action Area.

Increased deposition of suspended sediments during construction and decommissioning could impact the benthic prey/forage species of sea turtles, including SAV. The maximum deposition thickness (0.4 inch [1 millimeter]) would mostly be limited to an area 100 – 115 feet (30 – 35 meters) from the cable centerline; in areas where there are finer grain sediments, the maximum deposition thickness could increase locally up to 540 feet (165 meters) from the ECC cable centerline. It is anticipated that there will be a short-term impact on the availability of prey species within the area of direct impact; however, it is expected that this area will be recolonized within a short period of time after the Proposed Action is completed. Due to the small area in which benthic communities could be impacted relative the Action Area and the short-term nature of the impact, the Proposed Action is expected to result in negligible reductions in benthic shellfish and infaunal organisms that serve as prey for ESA-listed species (NMFS 2020a), including Atlantic sturgeon.

Overall, suspended sediment concentrations associated with the Proposed Action is considered to be below physiological thresholds for sturgeon and reductions in foraging opportunities for Atlantic sturgeon is found to be **insignificant**. Furthermore, such effects would be further reduced with the use of DP vessels and HDD sea-to-shore transitions to minimize sediment mobilization and seabed sediment alteration. Therefore, the effects of increased turbidity levels and sediment deposition from Project construction activities **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon**.**

5.5.4 Dredging

The short-term and long-term impacts of dredging to the benthic environment that have the potential to affect ESA-listed species are discussed in 5.5.3.1 and 5.5.3.2 and 5.5.4. During seabed preparation of the ECCs and HDD exit pit dredging, trailing suction hopper dredges and water injection dredges are expected to move at speeds between 1 to 3 knots while dredging while mechanical dredges would be stationary during dredging activities (Reilly 1950). The physical presence of dredging during the construction phase of the Proposed Action in the ECCs on ESA-listed species is discussed below. No dredging is anticipated in the Lease Area.

5.5.4.1 Marine Mammals

Marine mammals are not vulnerable to entrainment, impingement, or capture in dredge equipment, and ESA-listed marine mammals in the Project area do not consume benthic prey species that may be captured in dredge equipment where dredging is to occur. Therefore, the effects of dredging associated with the Proposed Action leading to physical interactions with the dredge or reduction in prey availability would have **no effect** on ESA-listed whale species.

5.5.4.2 Sea Turtles

Sea turtles are generally not vulnerable to entrainment in hydraulic dredges due to the small intake and relatively low intake velocity (NMFS 2018b). Hopper dredges may strike, impinge, or entrain sea turtles, which may result in injury or mortality (Ramirez et al. 2017 citing Dickerson et al. 1990; Ramirez et al. 2017 citing Dickerson et al. 1991; Ramirez et al. 2017 citing Reine et al. 1998; Ramirez et al. 2017 citing Richardson 1990). Mechanical dredging, including the use of a clamshell dredge, is not expected to capture, injure, or kill sea turtles (USACE 2020). The sea turtle species most often affected by dredge interactions are loggerhead sea turtles, followed by green sea turtles, then Kemp’s ridley sea turtles (Ramirez et al. 2017).

Sea turtles are most vulnerable to interactions with dredges when foraging on or near the bottom. As Kemp’s ridley sea turtle is the only species that forages in soft bottom habitats where dredging for the Project would occur, this species is likely at the highest risk. However, other sea turtle species are also expected to occur in the dredge area and have the potential to interact with dredge equipment. The risk of interactions between hopper dredges and sea turtles is expected to be low enough to be **discountable** in the offshore environment where dredging for seabed preparation in approximately five percent of the Falmouth ECC would be expected to occur (Michel et al. 2013; USACE 2020). Given the low likelihood of effects, physical interactions associated with dredging for the Proposed Action leading to injury or mortality **may affect, not likely to adversely affect** ESA-listed sea turtles.

Prey entrainment or benthic disturbance associated with dredging for the Proposed Action has the potential to reduce prey availability for ESA-listed sea turtle species that forage in soft bottom habitats (i.e., Kemp’s ridley sea turtle). These effects would be localized and short-term. Recolonization and recovery of prey species is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little time as 100 days (Dernie et al. 2003). Based on the short-term and localized nature of effects, the relatively small area affected, and the availability of similar foraging habitat throughout the Action Area, the effect of benthic habitat disturbance associated with dredging for the Proposed Action on Kemp’s ridley sea turtles would be too small to be meaningfully measured or detected and is thus **insignificant**. Dredging in the Project area is only anticipated to occur in five percent of the Falmouth ECC and at HDD exit pit locations. Research on benthic recovery has found that shallow, sandy environments exposed to strong natural disturbances typically recover quickly as strong bottom currents and storms infill anthropogenically disturbed patches of sediment (Meyer et al. 1981; Dernie et al. 2003). Additionally, benthic communities in high energy, shallow areas with surficial sediment movement are thought to be disturbance-adapted and quicker to recover from anthropogenic disturbances (Collie et al. 2000). Given the small scale of anticipated effects, prey entrainment and benthic disturbance associated with dredging for the Proposed Action leading to reduced prey availability **may affect, not likely to adversely affect** Kemp's ridley sea turtle. As green, leatherback, and loggerhead sea turtles do not forage in soft bottom habitats, the effects of prey entrainment and benthic disturbance associated with dredging for the Proposed Action leading to reduced prey availability would have **no effect** on these species.

5.5.4.3 Fish

Impacts from dredging during construction, could affect ESA-listed marine fish through impingement, entrainment, and capture associated with hydraulic dredging techniques.

Dredging during construction could carry a variety of impacts on Atlantic sturgeon related to injury and mortality associated with dredging techniques as well as impacts on prey. Adult Atlantic sturgeon are thought to have low abundance in the Project area (Dunton et al. 2010). The risk of interactions between sturgeon and dredges is thought to be highest in areas where large numbers of sturgeon are known to aggregate. However, there are no known areas of sturgeon aggregations within the Project area. As sturgeon are known to forage over soft-bottom sediments (Dadswell 2006), this behavior may increase the risk of interaction between sturgeon and dredges. For entrapment to occur, an individual sturgeon would have to be present directly below the dredge bucket at the time of operation. The risk of Atlantic sturgeon entrapment in mechanical dredges is low given the small area affected by the clamshell and the slow lowering speed of the bucket (NMFS 2018c)

Given the rarity of sturgeon in the areas to be dredged, the co-occurrence of an Atlantic sturgeon and the draghead of hydraulic dredges is extremely unlikely. As such, entrapment of sturgeon during the temporary performance of dredging operations is also extremely unlikely. Due to their bottom foraging and swimming behavior, adult Atlantic sturgeon have been known to become entrained in hydraulic-cutterhead dredges as they move across the seabed (Novak et al. 2017; Balazik et al. 2020; NMFS 2023g). Studies of sturgeon vulnerability to hydraulic dredges have demonstrated that fish would have to be within 3.3 to 6.6 feet (1 to 2 meters) of the dredge head to be at risk of entrainment (Boysen and Hoover 2009; Clarke 2011; Hoover et al. 2011). Therefore, the overall risk of Atlantic sturgeon entrainment in a hydraulic cutterhead dredge is low. Further, there is a lack of attraction or deterrence relationship observed between Atlantic sturgeon and dredges, the likelihood of effects on Atlantic sturgeon from dredging is low (Balazik et al. 2020; NMFS 2023g).

Sturgeon are vulnerable to entrainment in suction hopper dredges. However, this vulnerability is largely limited to juvenile sturgeon, which do not have the swimming capabilities of larger adults and are more likely to engage in bottom-holding behaviors (Hoover et al. 2011). Most Atlantic sturgeon in the offshore environment are expected to be larger subadults and adults, reducing sturgeon vulnerability to entrainment in suction hopper dredges in areas where dredging for the Project would occur. Given the life stages most likely to be present and the patchy distribution of Atlantic sturgeon in the offshore environment, interactions with suction hopper dredges are expected to be very unlikely and thus, **discountable**. Given the low likelihood of effects, the effects of physical interactions associated with dredging for the Proposed Action leading to injury or mortality **may affect, not likely to adversely affect** Atlantic sturgeon.

Juvenile Atlantic sturgeon are known to inhabit estuarine environments for up to a year before migrating out into the ocean (ASMFC 2012). Though the presence of SAV has been recorded in the Falmouth ECC that occurs in Massachusetts state waters, no known strong association has been documented between juvenile Atlantic sturgeon and SAV (ASMFC 1997). Additionally, only one Atlantic sturgeon was captured in a total of 5,563 bottom trawls in depths from 13 to 282 feet (4 to 86 meters) occurring in the spring and fall from 1978 to 2007 (Dunton et al. 2010). It is not anticipated that dredging due to inshore export cable installation would impact juvenile Atlantic sturgeon.

Atlantic sturgeon prey upon small bottom-oriented fish such as sand lance, mollusks, polychaete worms, amphipods, isopods, and shrimp, with polychaetes and isopods being the primary groups consumed in the Project area (Smith 1985, Johnson et al. 1997, Dadswell 2006). Sand lance could become entrained in a hydraulic dredge due to their bottom orientation and burrowing within sandy sediments that require clearing by the Proposed Action. Studies summarized in Reine and Clarke (1998) indicate a mortality rate of 38 percent for fish entrained by hydraulic dredging. It is expected that dredging in sand waves to allow for cable installation will result in the entrainment and mortality of some sand lance. Benthic infauna and epifauna will likely experience 100 percent mortality during dredging activities. However, given the size of the area where dredging will occur and the short duration of dredging, the loss of benthic invertebrates and sand lance will be small, temporary, and localized. With the opportunistic feeding nature of Atlantic sturgeon, it is expected that any impact from the loss of Atlantic sturgeon prey items would be small and cannot be meaningfully measured, evaluated, or detected, so it is **insignificant**. Therefore, the effects of entrainment from Project dredging leading reduced prey availability **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.5 Trenching

The noise, benthic habitat, and water quality effects for trenching are described in Sections 5.2.3, 5.2.4, 5.5.2.2, 5.5.2.3, and 5.5.3. Trenching is defined here as any activity associated with cable burial/direct installation (i.e., trenching does not include seafloor preparation). Seafloor preparation activities are achieved through dredging for seabed leveling and removal of sand waves, and plows and grabbers for boulder removal. Sand wave clearance dredging, described in Section 5.5.2.2 and Section 5.5.4, will occur over 5 percent of the Falmouth ECC while the main seafloor preparation activity prior to cable installation would be boulder removal.

While there are six types of equipment potentially used for trenching in the ECCs and four types of trenching equipment for the interarray cables, equipment would either be mechanical or jetting (Section 3.1.2.4). All trenching activities are expected to be conducted during the summer months. From the turbidity modeling conducted for the Proposed Action, trenching in the Falmouth ECC would take approximately 18 days; approximately 14 days would occur at distances 12 to 55 miles (20 to 88 kilometers) offshore in depths ranging from 69 to 131 feet (21 to 40 meters). The advance rate (movement of the equipment forward) is 0.1 miles/hour (200 meters/hour). Nearshore trenching activities from the landfall location to 12 miles (20 kilometers) offshore in depths ranging from 14 to 66 feet (4 to 20 meters) are expected to last 4 days at the same advance rate.

In the Brayton Point ECC, using the same jetting or mechanical trenching methods and the same advance rate, the total duration of trenching activities is 30 days. Trenching activity in Mount Hope Bay is expected over 6 miles (10 kilometers) for a duration of 48 hours at depths ranging from 3 to 32 feet (1 to 10 meters). Trenching activity in the Sakonnet River is expected over 11 miles (18 kilometers) for a duration of 90 hours at depths ranging from 26 to 66 feet (8 to 20 meters). Trenching activity offshore is expected over 73 miles (118 kilometers) for a duration of 590 hours at depths ranging from 26 to 66 feet (20 meters to 40 meters).

For trenching of the interarray cables in the Lease Area, a mechanical cutting or jetting ROV would be used. The advance rate is the same as export cable installation and trenching activity is expected over a maximum of 497 miles (800 kilometers) in depths ranging from 125 to 207 feet (38 to 63 meters).

The direct physical effects of trenching equipment during the construction phase of the Proposed Action on ESA-listed species is discussed below.

5.5.5.1 Marine Mammals

Marine mammals are not vulnerable to entrainment, impingement, or capture in trenching equipment. ESA-listed marine mammals in the Project area do not consume benthic prey species that may be killed by trenching equipment where trenching would occur. Therefore, the effects associated with the Proposed Action leading to physical interactions with trenching equipment or reduction in prey availability would have **no effect** on ESA-listed whale species.

5.5.5.2 Sea Turtles

Sea turtles are not vulnerable to entrainment, impingement, or capture in trenching equipment. Given the slow speeds of trenching equipment, it would be extremely unlikely for a physical interaction to occur. As discussed, impacts on prey from turbidity due to cable laying are likely insignificant. Further, the width of direct impacts from trenching (i.e., the area directly impacted by jetting/cutting), is expected to be 3.3 feet (1 meter), which is a very small area of potential prey mortality relative to the foraging area for sea turtles. Therefore, the effects of the physical interactions with trenching equipment would have **no effect** on sea turtles.

5.5.5.3 Fish

Atlantic sturgeon are not vulnerable to entrainment, impingement, or capture in trenching equipment. Given the slow speeds of trenching equipment, it would be extremely unlikely for a physical interaction to occur. As discussed, impacts on prey from turbidity due to cable laying are likely insignificant. Further, the width of direct impacts from trenching (i.e., the area directly impacted by jetting/cutting), is expected to be 3.3 feet (1 meter), which is a very small area of potential prey mortality relative to the foraging area for sea turtles. Therefore, the effects of the physical interactions with trenching equipment would have **no effect** on Atlantic sturgeon.

5.5.6 Presence of WTGs on Atmospheric/Oceanographic Conditions

Offshore wind facilities have the potential to impact atmospheric and oceanographic processes through the extraction of energy from the wind and the presence of structures in the water. There has been extensive research into characterizing and modeling atmospheric wakes created by offshore wind farms in order to design the layout of wind facilities and predict seabed scour but relatively few studies have analyzed the coupled hydrodynamic effects of atmospheric wakes and structure-induced turbulent wakes. Further, even fewer studies have analyzed wakes and their impact on regional scale oceanographic processes and potential secondary changes to primary production and ecosystem dynamics.

Oceanographic Effects due to Changes in Atmospheric Conditions

The extraction of wind energy by wind turbines can potentially alter atmospheric forcings that could affect surface mixing and lead to changes in local water flow at a fine scale near the WTGs. This atmospheric or wind wake phenomenon, characterized by reduced downstream mean wind speed and turbulence, can affect oceanographic processes as follows:

- Energy extraction can affect advection and Ekman transport. Advection and Ekman transport are directly correlated with shear wind stress at the sea surface boundary. Vertical profiles from Christiansen et al. (2022) exhibited reduced mixing rates over the entire water column. As for the horizontal velocity, the deficits in mixing were more pronounced in deep waters than in well-mixed, shallow waters, which is likely favored by the influence of the bottom mixed layer in shallow depths. In both cases, the strongest deficits in mixing rates occur near the pycnocline depth.

- Additional mixing downstream has been documented from Kármán vortices and turbulent wakes due to the pile structures of wind turbines (Carpenter et al. 2016; Grashorn and Stanev 2016; Schultze et al. 2020; Dorrell et al. 2022).
- Upwelling and downwelling dipoles under contact of constant wind directions affecting average surface elevation of waters have been documented as the result of energy extraction from offshore wind farms (Brostörm 2008; Paskyabi and Fer 2012; Ludewig 2015; Floeter et al. 2022). Mean surface variability was between 1 and 10 percent.
- With sufficient salinity stratification, vertical flow of colder/saltier water to the surface occurs in lower sea surface level dipoles and warmer/less saline water travels to deeper waters in elevated sea surface heights (Ludewig 2015; Christiansen et al. 2022; Floeter et al. 2022). This observation also suggested impacts on seasonal stratification, as documented in Christiansen et al. (2022).

A study of atmospheric wake effects by Daewel et al. (2022) contains model results of a hypothetical build out of 24,000 5 MW WTGs at a hub height of 295 feet (90 meters) in the North Sea. The modeling results showed that extremely large clusters of offshore wind turbines provoke large scale changes in annual primary productivity. Productivity was modeled to decrease in the center of large wind farm clusters but increased around these clusters in the shallow, near-coastal areas of the inner German Bight and Dogger Bank. These modeled changes in net primary production were found to reach up to 10 percent locally but remained below 1 percent both inside and outside of the offshore wind farm clusters when integrated over a larger scale. As a result of reduced average current velocities, model results also showed a reduction in bottom-shear stress leading to reduced resuspension of organic carbon, increased amounts of organic carbon in sediments, and changes to bottom water oxygen concentrations. While more pronounced locally compared to the region-wide average, changes in sedimentation, seabed processes, and spatial distribution of primary production have the potential to impact higher trophic levels and ecosystem function. The authors indicate the need for more research to assess the combined effects of atmospheric wakes and turbulent wakes induced by wind turbine foundations as the latter might counteract the stabilizing effect of the wind wakes (Daewel et al. 2022). These model results reflect a buildout of turbines that is almost 8 times the approximately 3,100 WTGs currently expected to be installed for all wind farms on the East Coast from Massachusetts to North Carolina.

While detectable changes to the atmospheric forces that affect sea surface mixing are likely to occur once wind farms on the Atlantic OCS become operational, the potential influence that these impacts will have on biological productivity remains uncertain given the different physical factors in the Project area than were modeled, the much lower number of wind turbines, and the larger size of wind turbines (2 to 3 times larger) planned for the Atlantic OCS compared to those modeled by Daewel et al. (2022).

In a modeling study focused on the buildout of larger-sized WTGs (up to 15 MW and 150-meter hub height) on the U.S. northeast shelf, on average, meteorological changes at the surface induced by next-generation extreme-scale offshore wind turbines (diameter and hub height greater than 492 and 328 feet [150 and 100 meters], respectively) will be nearly imperceptible (Golbazi et al. 2022). The authors simulated the potential changes to near-surface atmospheric properties caused by large offshore wind facilities in the summer and found significant wind speed reduction at hub height within the wind farm (up to 2 meters per second or a 20-percent reduction) that decreased with downwind distance from the wind farm. However, at the surface, an average wind speed deficit of 0.5 meters per second or less (10-percent maximum reduction) was found to occur within the wind farm footprint along with a slight cooling effect (-0.06 Kelvin on average). In comparison, studies on the effects of WTG wind wakes in the North Sea have identified the reduction in wind-induced mixing as the catalyst to changes in upper ocean dynamics (Ludewig 2015; Christiansen et al. 2022) and biological productivity (Daewel et al. 2022). Given the lower wind speed reductions (10-20 percent) reported by Golbazi et al. (2022) for the larger wind turbines planned for the U.S. Atlantic OCS compared to a wind speed reduction of up to 43-percent for smaller turbines in the North Sea (Platis et al. 2020), it is plausible that the observed effects from the reduction in wind-induced mixing would also be lessened. However, more region-specific research is still needed to validate this assumption.

Christiansen et al. (2022) modeled the wake-related wind speed deficits that occur due to wind farms in the southern and central North Sea and the resulting larger-scale disturbances on hydrodynamics and thermodynamics. The results of this modeling study predicted surface wind speed reductions potentially extending over tens of kilometers downwind from offshore wind turbine arrays leading to reductions in sea surface currents and potential alterations to temperature and salinity distributions and stratification. Wind wakes and their impacts on hydrodynamic patterns that extend outside the borders of wind farm developments can potentially lead to broadscale effects on nutrient availability, primary production, and ecosystem dynamics (Christiansen et al. 2022; Dorrel et al. 2022; van Berkel et al. 2020). While observations and model scenarios of wind wakes associated with wind energy fields have been generated for wind farms in the North Sea (Schultze et al. 2020; Daewel et al. 2022; Christiansen et al. 2022), there is still uncertainty regarding the applicability of those models to the oceanographic environment of the northeastern U.S. continental shelf (van Berkel et al. 2020; Miles et al. 2021).

In consideration of the physical and biological factors present in the Project Area, a recent report by the National Academies of Sciences, Engineering, and Medicine (NASEM 2024) evaluated the potential effects of offshore wind development on the oceanic physical processes and hydrodynamics of the Nantucket Shoals region of the U.S. northeast continental shelf with an emphasis on North Atlantic right whale foraging and prey resources. This report determined that potential ecological impacts due to the presence of wind turbines in this region is difficult to predict due to the lack of observational studies and the uncertainty of 247nstall247 hydrodynamic effects at the turbine, wind farm, and regional scales. The report further concludes that the hydrodynamic impacts on zooplankton productivity and distribution would be difficult to isolate from the significant impacts of climate change or other influences on the Nantucket Shoals regional ecosystem. The report recommended further observational studies, 247nstall247247, and monitoring throughout the various phases of wind energy development to better understand the potential influences of wind turbine structures on the factors shaping regional oceanography and ecology.

Hydrodynamic Effects of In-Water Structures

The presence of WTG vertical structures such as towers and foundations in the pelagic environment may affect the flow of water within and near the Lease Area. The general understanding of offshore wind–related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. When water flows around the structure, turbulence is introduced that influences local current speed and direction, which may increase vertical mixing (Segtnan and Christakos 2015; Grashorn and Stanev 2016; Carpenter et al. 2016; Cazenave et al. 2016). Schultze et al. (2020), using field measurements and numerical simulations, determined that narrow turbulent wakes occurring downstream of monopiles were strongest within the first 164 to 328 feet (50 to 100 meters) and dissipated within 984 feet (300 meters) past the structure. Modeling analyses (e.g., Cazenave et al. 2016) and remote sensing studies (e.g., Vanhellemont and Ruddick 2014) have also found turbulent wakes extending up to one kilometer from monopile foundations. Modeling studies on the wind facility-induced effects on mixing and stratification depend on a number of factors including turbine size and orientation, number of wind turbines, local atmospheric and oceanographic conditions, and model input parameters (Miles et al. 2021). While model simulations in European wind farms have shown changes to mixing and stratification downstream of pilings and a potential for cascading ecological effects, discerning the wind facility-induced effect signal from location-specific natural variability in environmental conditions can be challenging (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). As environmental conditions in the northeast U.S. shelf differ from European wind farm sites in the North Sea (e.g., seasonal stratification), more research is needed to identify the magnitude and type impact offshore wind farms will have on ocean processes specific to the U.S. Atlantic OCS (Hogan et al. 2023)

Water column impacts are heavily dependent on factors such as foundation type and oceanographic conditions (e.g., currents, well-mixed to stratified waters, and depth). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). Dorrell et al. (2022) state that offshore wind growth may fundamentally change shelf sea systems, particularly in seasonally stratified seas, but enhanced mixing could positively affect some marine ecosystems. The presence of foundations could increase vertical mixing driven by currents flowing around the foundations (Christiansen et al. 2022; Carpenter et al. 2016; Schultze et al. 2020). During times of stratification (summer), increased mixing due to the presence of structures could alter marine ecosystem processes by possibly increasing pelagic primary productivity in local areas (English et al. 2017; Degraer et al. 2020). That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the foundations. However, biological changes in the demersal community due to increased local fecal pellet excretions from mussels on and around the structures have been observed over relatively small distances of (<164 feet [50 meters]) (Maar et al. 2009). When the stratified water column is redirected around the structure, deeper, colder, nutrient-rich water mixes with warmer surficial nutrient-poor water. Installed structures pierce through separation barriers, such as the thermocline, increasing nutrient fluctuations similar to waves flowing over seafloor sand banks (Dorrell et al. 2021). The mass balance of the Lease Area may change as vertical mixing and transport will alter nutrient cycling and energy flow around structures, such as the uptake and benthic resupply of oxygen (Dorrell et al. 2020).

Results from recent hydrodynamic modeling studies specific to U.S. offshore wind developments in the Southern New England region and the effects of wind farm structures on larval transport and dispersal (Chen et al. 2021; Johnson et al. 2021) found that WTGs alter vertical mixing, horizontal advection, and horizontal turbulent dispersion (Chen et al. 2021) and that the introduction of the offshore wind structures into the offshore WEA modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting energy from the wind (Johnson et al. 2021). Both studies found discernable changes in larval dispersion and settlement for their target species (Chen et al. 2021: Atlantic sea scallop; Johnson et al. 2021: Atlantic sea scallop, silver hake, summer flounder) resulting from the hydrodynamic effects of wind turbine structures. Changes in distribution patterns of modeled planktonic larvae from offshore wind development in the Southern New England region suggests that similar impacts could affect other zooplankton species including the prey resources of higher trophic level organisms. As model results from Chen et al. (2021) and Johnson et al. (2021) are limited by their temporal, spatial, or species-specific input parameters, future modeling studies should focus on assessing impacts over multiple years and spawning seasons to reveal long-term structural shifts in larval settlement patterns, analyzing additional species and life stages, and evaluating impacts from multiple offshore wind development scenarios and locations (Hogan et al. 2023). Currently, an updated hydrodynamic modeling study (BOEM Study AT-22-01A: Offshore Wind Impacts on Oceanographic Processes) that makes use of a fine resolution PyWake model (characterized at the individual wind turbine scale) is being conducted by BOEM to better characterize the effects of wind wakes from wind turbines on sea surface stress in the Atlantic OCS. Preliminary results from this study have suggested lesser wind farm induced effects on hydrodynamics and larval dispersal in the RI MA WEA than what was previously described in Johnson et al. (2021), indicating impacts may be less pronounced.

5.5.6.1 Marine Mammals

In current shallow-water offshore wind farms where levels of turbulence are high, in-water wakes have been observed due to the presence of the monopiles as cylindrical structures that affect flow and the extraction of wind energy by turbines (Dorrell et al. 2022). At a regional level, Johnson et al. (2021) modeled the effects on larval transport from the full build out of the entire southern New England Lease Areas. This study showed that the changes to depth-averaged currents vary on the order of +11 percent to -8 percent, and many of the results on the higher ends of this range occurred in the regions north and south of the Lease Areas. Changes in currents east of the Lease Areas, in the region of Nantucket Shoals, were minor. Johnson et al. (2021) also showed a relative deepening in the thermocline of approximately 3 to 7 feet (1 to 2 meters) and a retention of colder water inside the Lease Areas through the summer months compared to the situation where turbines were not present. Chen et al. (2016) assessed how wind turbines would affect oceanographic processes during storm events and found that the deployment of wind turbines in the proposed Massachusetts and Rhode Island offshore region would not have a significant influence on southward larval transport from the upstream Georges Bank and Nantucket Shoals areas to the Mid-Atlantic Bight, although it could cause increased cross-shelf larval dispersion. Thus, the potential effects on marine mammal prey species, and therefore marine mammals, from changes to oceanographic and hydrodynamic conditions caused by the presence of offshore structures are not fully understood at this time but may conservatively range from 100 meters to tens of kilometers (Dorrell et al. 2022, Christiansen et al. 2022) and likely to vary seasonally and regionally.

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 (NMFS 2021a). Broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). Wake effects from the turbine structures in water can induce mixing of stratified water columns especially in the summer months; this could mean more nutrients are available to surface waters or disperse nutrient-poor surface water (Christiansen et al. 2022). With sufficient salinity stratification, vertical flow of colder/saltier water to the surface occurs in lower sea surface level dipoles and warmer/less saline water travels to deeper waters in elevated sea surface heights (Ludewig 2015; Christiansen et al. 2022). This observation also suggested impacts on seasonal stratification, as documented in Christiansen et al. (2022). However, the magnitude of salinity and temperature changes with respect to vertical structures is small compared to the long-term and interannual variability of temperature and salinity (Christiansen et al 2022).

Changes to vertical mixing dynamics would be most relevant to NARWs, as they are the only listed species in the region specializing in prey (Calanoid copepods) whose aggregations are entirely driven by hydrodynamic processes. And have the lowest population numbers of all of the ESA-listed marine mammals. While fin and sei whales also feed on copepod species, including *Calanus finmarchicus*, *Calanus*, *Pseudocalanus*, and *Centropages* copepods, which are most abundant in the spring and summer, are the primary foraging resource for NARWs. New England waters are an important feeding habitat for NARW after recent shifts in distribution have led to increases in documentation of NARW around Nantucket Shoals and areas east of the Massachusetts WEA (Hayes et al. 2020; Quintana-Rizzo et al. 2021) with foraging primarily occurring between the months of January and April. Zooplankton abundance in the northeast US continental shelf has held at a consistent level over the past 20 years with slight inter-annual variability (NEFSC 2018a) and, more recently, showing increased species diversity of zooplankton with increased krill and gelatinous zooplankton, and periodic shifts between larger copepods such as *Calanus finmarchicus* and smaller copepods (NEFSC 2022). Aggregations of plankton, which provide a dense food source for NARWs to efficiently feed upon, are concentrated by physical and oceanographic features. Increased mixing from structure-induced turbulent wakes could disperse these plankton aggregations, thereby decreasing efficient foraging opportunities. Water moving around foundations may also form eddies (Chen et al. 2016) which could concentrate aggregations of zooplankton and increase efficient foraging. The exact outcome is currently unknown but would depend heavily on site-specific environmental conditions. In order for effects to occur, NARW present in this area would have to be foraging on prey that could be affected by changes to oceanographic processes and any changes to those processes would have to be large enough to alter the availability of NARW prey to a biological meaningful extent. In the Southern New England region, only two studies have modeled the hydrodynamic effects of offshore wind development and evaluated the potential impacts on the dispersal and settlement of planktonic larvae (Chen et al. 2021; Johnson et al. 2021). Both studies found changes in regional larval distribution patterns which suggests similar impacts may occur with planktonic prey resources of ESA-listed whale species.

There is considerable uncertainty as to how these broader ecological changes will affect marine mammals in the future, and how those changes will interact with other human-caused impacts. A recent report by the National Academies of Science Engineering and Medicine evaluated the potential of offshore wind farms to alter the hydrodynamic processes that impact prey abundance and availability in the Nantucket Shoals region, a biologically important area for NARWs (NASEM 2024). The report highlighted the dramatic effects of climate change already observed over Nantucket Shoals and the surrounding region. The study concluded that impacts of offshore wind projects on the NARW and the availability of their prey will likely be difficult to distinguish from the significant impacts of climate change and other influences on the ecosystem, and suggested the need for further research and monitoring to better understand the regional effects offshore wind development may have on oceanography and ecology . Further monitoring studies will be needed to have the spatial and temporal coverage to adequately understand the impact of future wind farms and BOEM will continue to coordinate with partners to develop regional monitoring strategies to obtain scientific information on the potential hydrodynamic effects of WTGs.

The long-term adverse effects of the increased presence of structures on marine mammals and their habitats would likely vary by species. For sperm whales, which may be in the area but do not rely on oceanographic features for foraging, and blue whales which typically occur farther offshore in areas with depths of 328 feet (100 meters) or more (Waring et al. 2011) and unlikely to occur near enough to Project activities to experience any changes driven by wake effects, there would be **no effect.** For fin whale, sei whale, and NARW, adverse effects could potentially occur depending on the significance of changes in hydrodynamics on distribution and availability of prey species. For fin and sei whales, this significance is likely to be low since they feed on other prey whose distributions are not dependent on frontal features or hydrodynamics. Sei whales are more euryphagous than fin whales or NARWs and will feed on copepods, krill, and small fish such as anchovies (Mizorch et al. 1984). While fin and sei whales inhabit similar ranges in higher latitudes, sei whales can be found farther offshore and may co-occur with NARWs in the spring to forage on copepod prey. For NARW, adverse effects may be greater because their population size is so small that the loss of an individual could have a population-level effect. The impacts of changes to oceanographic conditions caused by the presence of offshore structures on marine mammal prey species and, therefore, marine mammals are difficult to discern and likely to vary seasonally and regionally. While broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020), there is considerable uncertainty as to the magnitude and extent of these changes, especially when coupled with broader ecological changes such as climate change. Available empirical evidence of offshore wind farm induced hydrodynamic impacts are from studies on European wind facilities in oceanographic conditions (e.g., stratification, water depth) that differ from the U.S. Atlantic OCS (Hogan et al. 2023). As such, more region-specific research would be necessary to better understand the hydrodynamic impacts on marine mammals and their prey.

There remains a large amount of uncertainty around the potential impacts offshore wind facilities may have on large whales due to the novelty of this type of development in the Southern New England region.

While monitoring studies would allow for a more precise determination of windfarm induced changes in whale behavior, long-term and intermittent impacts on foraging and migration may potentially occur as a result of Project activities. Temporary displacement of whales into areas with higher risk of interactions with fishing and commercial vessels may also contribute to impacts on marine mammals. Potential increases in aggregations of prey species may result in slight beneficial effects, however, these have the potential to be offset by risk of entanglement in fishing gear for displaced marine mammal species. With the uncertainty surrounding the hydrodynamic effects of offshore wind development on marine mammal forage resources in the area in and around Nantucket Shoals, the impact on foraging is currently unknown but unlikely be distinguishable from natural variability or from impacts of climate change. Based on what is currently known on the relative contribution of beneficial and adverse impacts from offshore wind development in the Southern New England region on ESA-listed marine mammal species, impacts on marine mammals would be detectable and measurable but are not anticipated to lead to population-level effects for most species. While effects on the environment and prey of ESA-listed whale species may occur, the overall impact is likely to be **insignificant.** Therefore, changes in oceanographic conditions and hydrodynamics due to the presence of structures in the water **may affect, not likely to adversely affect** fin whales, sei whales, and NARWs**.**

5.5.6.2 Sea Turtles

Net primary productivity is driven by photosynthesis in marine phytoplankton and accounts for half of global-scale photosynthesis supporting major ocean ecosystem services (Field et al. 1998). There are few empirical studies showing the impact of WTGs on ocean stratification (Tagliabue et al. 2021), although recent models have demonstrated the occurrence of enhanced ocean mixing due to the presence of WTGs in the North Sea (Carpenter et al. 2016; Floeter et al. 2017, Dorrell et al. 2022). However, interannual changes in net primary productivity in the North Atlantic are poorly correlated with parallel changes to stratification. Tagliabue et al. (2021) emphasizes the importance of other physical mechanisms, especially the Gulf Stream. Potential impacts on net primary productivity in the North Atlantic from offshore wind projects may occur, however, in the absence of additional data, these impacts are considered negligible when compared with the effects of the Gulf Stream. Wake impacts would likely be permanent but may vary seasonally and regionally.

The presence of in-water structures could reduce water flow immediately downstream of foundations but return close to background levels within approximately eight pile diameters downstream of the pile center (Miles et al. 2017). Fine-scale effects on water flow could have localized impacts on prey distribution and abundance. As a result of the atmospheric wake effect, reductions in sea surface currents leading to alterations in upper ocean dynamics can potentially extend over tens of kilometers downwind from offshore wind turbine arrays (Christiansen et al. 2022). Regional hydrodynamic effects could affect prey species at a broader scale. Effects on surface currents could also influence patterns of larval distribution (Chen et al. 2021; Johnson et al. 2021) and seasonal mixing regimes could influence primary productivity, both of which could, in turn, affect the distribution of fish and invertebrates on the OCS (Chen et al. 2018; Lentz 2017). Hydrodynamic alterations due to the presence of WTGs could increase primary productivity in the vicinity of the structures (Carpenter et al. 2016; Schultze et al. 2020). However, such an increase would be highly localized, and the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles.

Green sea turtles, loggerhead sea turtles, and Kemp's ridley sea turtles consume prey that are not strongly tied to physical oceanographic features such as currents and upwelling. However, leatherback sea turtles consume planktonic prey that are not able to move independently of normal ocean currents. Leatherback sea turtles are known to follow jellyfish aggregations, and thus forage around areas of upwelling (Bailey et al. 2012). Nantucket Shoals, along with areas on Georges Bank and the edge of the continental shelf, have been found to create hotspots of prey for leatherback sea turtle foraging. The tidal mixing and upwelling in areas such as Nantucket Shoals increases productivity and gelatinous zooplankton numbers (Dodge et al. 2014). Since the leatherback sea turtle is the most pelagic of the ESA-listed turtles, it is expected to be the most affected by local and regional hydrodynamic changes.

The presence of WTGs in the Project area may influence the distribution of jellyfish and, thus, affect the distribution of leatherback sea turtles. In addition to currents, the abundance and distribution of jellyfish are influenced by sea surface temperature and zooplankton prey availability (Gibbons and Richardson 2008). Changes in nutrient cycling resulting from altered oceanographic conditions due to the presence of WTG substructures may also affect jellyfish distributions. However, current research suggests that these changes could be highly localized (Floeter et al. 2017; Miles et al. 2017; Schultze et al. 2020) causing minimal impacts to the foraging resources of leatherback sea turtles. In addition, given the widespread range of leatherback sea turtle prey (NMFS and USFWS 2020a), foraging resources would be available outside of the Project area if any alterations to jellyfish abundances were to occur.

In summary, the presence of WTGs is expected to result in wind-wake alterations in and around offshore wind Project areas. Changes to ocean stratification and nutrient supplies in the upper ocean in response to wind wakes can alter net primary productivity as suggested by Floeter et al. (2022) and Daewel et al. (2022). Wind wake may also disturb planktonic transport, and thus, prey availability for sea turtles (van Berkel et al. 2020). Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing. During summer, when water is more stratified, increased mixing could result in localized increases in primary productivity near the structures. However, the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

Given the uncertainty around regional atmospheric and oceanographic offshore wind farm effects post-construction and the possibility of both increasing and decreasing prey availability depending on multiple environmental and Project-specific factors, impacts to sea turtle prey species and sea turtles from changes in hydrodynamics are not known at this time but are likely to vary both seasonally and regionally. Given the current body of knowledge on sea turtle prey availability and potential effects on prey resources from offshore wind farm development in the U.S. Atlantic offshore WEA, the overall impact on sea turtles and their prey would be so small that it cannot be meaningfully measured, evaluated, or detected and will be **insignificant**. Therefore, changes in oceanographic conditions and hydrodynamics due to the presence of structures **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.6.3 Fish

As described for sea turtles in Section 5.5.6.2, the presence of WTGs associated with the Proposed Action may lead to localized increases in primary productivity, but these increases may not translate to increases in prey for ESA-listed fish species. The presence of WTGs may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). Increased mixing may result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. However, interannual changes in net primary productivity in the North Atlantic are poorly correlated with parallel changes to stratification and emphasize the importance of other physical mechanisms, especially the Gulf Stream (Tagliabue et al. 2021).

The presence of WTGs is likely to create localized hydrodynamic effects that could have small-scale impacts on food web productivity and the dispersal of pelagic eggs and larvae. The addition of vertical structures that spans the water column could alter vertical and horizontal water velocity and circulation. The Project area is considered seasonally stratified, with warmer waters and high salinity leading to strong stratification in the late summer and early fall. The presence of WTG foundation structures in the water column can introduce vertical mixing and turbulence that also results in some loss of stratification (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017).

Wind turbine foundation structures can also influence current speed and direction. Monopile turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is evidence of hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). However, other work suggests the influence of a monopile is primarily limited to within 328 to 656 feet (100 to 200 meters) of the pile (Schultze et al. 2020). The discrepancy is related to local conditions, wind farm scale, and sensitivity of the analysis. Based on these studies, the turbulent wake effects from monopile foundation structures could occur from 328 to 3,280 feet (100 to 1,000 meters) downstream of each monopile. Hydrodynamic changes at this scale could have localized effects on food web productivity and the transport of pelagic eggs and larvae. Given their planktonic nature, altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, altering their survivability. Additionally, pelagic juveniles and adults utilizing water column habitat may experience localized hydrodynamic effects down current of each monopile making these pelagic habitats potentially unsuitable. Most juvenile and adult fishes are expected to elicit an avoidance behavioral response away from unsuitable habitat within the turbulent wake of turbine foundation structures. Regional scale hydrodynamic effects resulting from atmospheric or wind wakes that may extend over tens of kilometers outside the borders of wind farm arrays can potentially lead to broadscale changes in nutrient availability, primary production, and ecosystem dynamics (Christiansen et al. 2022; Dorrel et al. 2022; van Berkel et al. 2020), as well as alter larval dispersion and settlement on a regional scale (Chen et al. 2021; Johnson et al. 2021). However, the cascading effects on trophic ecology and spatial distribution of fish species in the U.S. Atlantic OCS, such as the Atlantic sturgeon, from wind turbine induced changes in local and regional ocean dynamics are not yet fully understood and requires further study.

Changes in hydrodynamics resulting from the presence of structures offshore, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown. Most research conducted to date have had difficulty disentangling hydrodynamic impacts on fish populations from natural variability (van Berkel et al. 2020). Any impacts on primary productivity associated with Project structures are expected to have little effect on ESA-listed fish species. Johnson et al. (2021) determined that the presence of structures in the Southern New England offshore environment could affect planktonic larval dispersal patterns, leading to increases in larval settlement density in some areas and decreases in others. For Atlantic sturgeon, these changes are not anticipated to translate to measurable population effects as their eggs and larvae are confined to riverine systems and juveniles do not enter the marine environment before they are two years old. In the marine environment, Atlantic sturgeon prey on benthic invertebrates and small fish (e.g., sand lance). While potential impacts on larval dispersion and survival of Atlantic sturgeon prey species may occur, structure-induced hydrodynamic effects are not expected to impact overall prey distribution or availability. Given the current body of knowledge on Atlantic sturgeon life history and potential effects on their prey resources from offshore wind farm development in the Southern New England offshore WEA, the overall impact on Atlantic sturgeon and their prey would be so small that they cannot be meaningfully measured, evaluated, or detected and will be **insignificant**. Therefore, changes in oceanographic conditions and hydrodynamics due to the presence of structures **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.7 Physical Presence of WTGs on Listed Species

In addition to effects on hydrodynamics and oceanographic conditions (Section 5.5.6), the physical presence of WTGs in the water during operation may have direct effects on ESA-listed species in the Action Area through behavioral disruptions like avoidance, displacement, or attraction. Long-term, minor, indirect adverse impacts could also occur as a result of increased interaction with active or abandoned fishing gear encountered near the structures.

5.5.7.1 Marine Mammals

The presence of structures associated with the Proposed Action over the life of the Project would modify pelagic habitats used by marine mammals and their prey, and their presence could affect marine mammal behavior. However, the likelihood and significance of these effects are uncertain.

The 149 foundations would be placed in a grid-like pattern with approximate spacing of 1 nautical mile (2 kilometers) between WTG and OSP locations. Based on documented body lengths (Wynne and Schwartz 1999), the largest NARW (59 feet [18 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two foundations spaced at 1 nautical mile (2 kilometers) 80 to 100+ times over. Although spacing between the structures would be sufficient to allow marine mammals to use habitat between and around structures, information about large whale responses to offshore wind structures is lacking. The presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

The presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns. The evidence for long-term displacement is unclear and varies by species. For example, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial Lease Areas in Denmark. In contrast, other studies have documented apparent increases in marine mammal density around wind energy facilities. Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently attracted by the abundant concentrations of prey created by the artificial reef effect. The study of long-term exclusion or attraction effects was identified as a priority research topic by Kraus et al. (2019) as little is currently known about the behavioral changes of large whales due to the presence of WTGs.

The presence of structures could also concentrate recreational and commercial fishing around foundations, potentially increasing the risk of marine mammal entanglement in both lines and nets and increasing the risk of injury and mortality due to infection, starvation, or drowning (Moore and van de Hoop 2012). These structures could also result in fishing vessel displacement or gear shift, which might result in additional exposure to commercial and recreational fishing activity. Alternatively, displacement of fishing activity between WTG structures could potentially reduce interactions with commercial and recreational fishing gear within the project footprint but could increase interactions outside the wind farm area. The potential impact on marine mammals from these changes is uncertain. However, if a shift from mobile gear to fixed gear occurs due to inability of the fishermen to maneuver mobile gear, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species' recovery (Knowlton et al. 2012). NMFS estimates that over 85 percent of individuals have been entangled in fishing gear at least once (Hayes et al. 2023) and 60 percent of individuals show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021, Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). In 2021, there were five active entanglements/entrapment cases, three of which were new. Of the three newly entangled whales (with attached gear), two were in U.S. waters and one in Canadian waters. When factoring in entanglement scars, seven additional entanglement events occurred in Canadian waters and four in U.S. waters in 2021 (Pettis et al. 2022). In 2023, eight active entanglement cases reported between January 1 and December 31, six of which were new entanglement events and two were previously reported in 2022 (Pettis and Hamilton 2023). Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). Abandoned or lost fishing gear may become tangled with foundations, which could reduce the chance of marine mammals encountering free-floating abandoned gear in the area, but debris tangled with WTG foundations could still pose a hazard to marine mammals, particularly if they prove to be attracted to the structures. While these potential long-term impacts would be of low intensity, an increase of NARW presence in the wind farm area, alongside a potential shift to fixed gear leading to more vertical lines, could significantly affect NARW population. Such risks could persist until decommissioning is complete and structures are removed.

As discussed in Section 5.5.6.1, impacts from the presence of structures on hydrodynamic patterns in the nearby Nantucket Shoals are an important consideration for marine mammals and especially NARWs, which are known to forage in the Nantucket Shoals region. O’Brien et al. (2021) found that NARWs occurred in the greatest numbers in southern New England between December and February although they also occur in other months in lower numbers. The tidal currents on Nantucket Shoals are intense and the water column remains well mixed throughout the year (O’Brien et al. 2020), which would be expected to generally prevent the formation of thin, vertically compressed layers of copepods that allow for efficient NARW feeding (Baumgartner and Mate 2003; Baumgartner et al. 2017). In other regions, NARWs feed on copepods in well-mixed waters during winter, but during other times of the year, they preferentially feed on the larger and more nutritious life stages of *Calanus finmarchicus*. To explain NARW presence near Nantucket Shoals when their preferred prey may be available elsewhere in more stratified waters, O’Brien et al. (2020) speculated NARWs are either feeding inefficiently on smaller copepod species or that they are feeding on a different non-copepod prey species that are more nutritious or can be ingested efficiently despite the strong tidal currents (e.g., a large-bodied bottom associated/clinging amphipod). Gammarid amphipods occur in abundant patches on the western edge of Nantucket Shoals where NARWs are also found (White and Veit 2020). While Nantucket Shoals is well mixed, it is possible the strong currents could serve to aggregate prey patches along ephemeral frontal boundaries or along the edges of the tidal jet running along the western side of the Shoals (comment from NMFS).

In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (i.e., fish and decapod crustaceans) (Causon and Gill 2018; Taormina et al. 2018). Foundations and scour protection would create an artificial reef effect (Degraer et al. 2020), likely leading to enhanced biological productivity and increased abundance and concentration of fish and invertebrate resources (Hutchison et al. 2020). This could alter predator–prey interactions in and around the Lease Area, with uncertain and potentially beneficial or adverse effects on marine mammals. For example, fish predators like seals and porpoises could benefit from increased biological productivity and abundant concentrations of prey generated. However, any increase in biomass is anticipated to be small and localized, and it is not expected that reef effect would result in an appreciable increase in the primary prey species of NARWs, fin whales, or sei whales (NMFS 2021a).

Given the uncertainty regarding marine mammal responses to the presence of offshore wind structures, BOEM cannot discount the possibility that the presence of structures could have long-term impacts on foraging, migration, and increased risk of entanglement in fishing gear associated with the foundations. However, secondary entanglement risks resulting from marine debris (e.g., derelict commercial fishing gear) is not subject to BOEM’s marine debris reporting and recovery requirements. In light of this risk, BOEM proposes a monitoring condition that help monitor for any potential debris around WTG foundations. Monitoring, identification, and reporting of debris not associated with the Proposed Action will provide valuable information to assess if such risks are present so appropriate actions may be taken. The BOEM proposed measure BA-31 (Table 3.3-2) would require the Lessee to survey ten different WTGs annually via underwater imagery or divers to determine the frequency and locations of marine debris. Surveys will collect associated data on location, pile identification number, images, videos, disposition of located debris (removed or left in place), and any animals sighted and submit to BOEM in an annual report. 256nstall256n, best management practices will be coordinated with NOAA's marine debris program. However, based on the lack of reported derelict fishing gear in the area, the likelihood of secondary entanglement is **discountable.** Thus, any effects due to the presence of WTGs during operations **may affect, not likely to adversely affect** ESA-listed marine mammal populations.

5.5.7.2 Sea Turtles

In the Gulf of Mexico, loggerhead, leatherback, green, and Kemp's ridley sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Hastings et al. 1976). Sea turtles would be expected to use habitat in between the WTGs and around structures for feeding, breeding, resting, and migrating for short periods, and residency times around structures may increase with the age of structures if communities develop on and around foundations. Impacts on sea turtles could result from the reef effect created by the presence of up to 149 foundations and between 390 acres (157 hectares) to greater than 1,700 (> 686 hectares) of scour/cable protection. Studies have found increased biomass for benthic fish and invertebrates around artificial structures (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019), indicating that offshore wind facilities could generate beneficial permanent impacts on local ecosystems, which may lead to behavioral changes related to foraging activities. The WTG and OSP foundations would provide some level of reef effect, likely increasing local prey availability, and may result in minor, long-term beneficial impacts on sea turtle foraging and sheltering. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

While the anticipated reef effect may result in long-term beneficial impacts on sea turtles, some potential exists for increased vessel interaction (Section 5.4.1) and exposure to fishing gear that could lead to entanglement, ingestion, injury, and death. The reef effect due to presence of structures may concentrate recreational fishing around foundations and would also increase the risk of gear loss or damage. This could cause entanglement, especially with monofilament line, and increase the potential for entanglement in both lines and nets leading to injury and mortality due to abrasions, loss of limbs, and increased drag, resulting in reduced foraging efficiency and ability to avoid predators (Barnette 2017; Berreiros and Raykov 2014; Foley et al. 2008). The reef effect may attract recreational fishing effort from inshore areas and attract sea turtles for foraging opportunities, resulting in a small increase in risk of entanglement and hooking or ingestion of marine debris where fishers and turtles are concentrated around the same foundations. In addition to the risk of impacts from fishing gear, the artificial reef may also attract sea turtle predators to the area, increasing sea turtle predation risk. While secondary entanglement risks resulting from marine debris (e.g., derelict commercial fishing gear) is not subject to BOEM's marine debris reporting and recovery requirements, BOEM proposes a monitoring condition that would help monitor for any potential debris around WTG foundations. Monitoring, identification, and reporting of debris not associated with the Proposed Action will provide valuable information to assess if such risks are present so appropriate actions may be taken.. The BOEM proposed measure BA-31 (Table 3.3-2) would require the Lessee to survey ten different WTGs annually via underwater imagery or divers to determine the frequency and locations of marine debris. Surveys will collect associated data on location, pile identification number, images, videos, disposition of located debris (removed or left in place), and any animals sighted and submit to BOEM in an annual report. In addition, best management practices will be coordinated with NOAA's marine debris program.

Contrasting the potential attraction due to the reef effect, the presence of WTG structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. However, the habitat quality for sea turtles does not greatly vary within and around the Project area. Any avoidance or displacement is expected to be short term and insignificant.

Structures may also reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders and further altering the prey availability to sea turtles. Leatherback sea turtles are known to forage around oceanographic features, such as upwellings, that lead to an aggregation of jellyfish (Bailey et al. 2012). The Nantucket Shoals, located northeast of the Project area, provides a foraging ground for leatherback sea turtles. The addition of structures in the area has the potential to cause hydrodynamic effects that might alter the distribution of the leatherback's planktonic jellyfish prey, but there is uncertainty around these potential effects. Changes in ocean mixing and thermal stratification, while small compared to other naturally occurring mixing mechanisms (Schultze et al. 2020), could also influence sea turtle dive behavior and thermoregulation. Any potential long-term, intermittent impacts could persist until decommissioning is complete and structures are removed.

Due to the patchy distribution and low densities of sea turtles within 3 miles (5 kilometers) of the SouthCoast Lease Area (< 1 turtle per 100 square kilometers in and near the Lease Area for all species in any season), the overall impact of displacement, reef effect, or increased entanglement risk on sea turtles is expected to be so small that it cannot be meaningfully measured, evaluated, or detected and will be **insignificant**. Therefore, the physical presence of structures in the Project area during operations **may affect**, **not likely to adversely affect** ESA-listed sea turtles.

5.5.7.3 Fish

The addition of new hard surfaces and structures, including WTG and OSP foundations, scour protection, and hard protection on top of cables, to a mostly sandy seafloor would create a more complex habitat in the Project area. Structure-oriented finfish species such as black sea bass, striped bass, and Atlantic cod (among others) would be attracted to these more complex structures. The structures would create an artificial reef effect, whereby more sessile and benthic organisms would likely colonize the structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones) and increases in primary productivity could occur. Higher densities of filter feeders, such as mussels that colonize the structure surfaces, could consume much of the increased primary productivity but also provide a food source and habitat to crustaceans such as crabs (Dannheim et al. 2020), increasing the biomass and modifying food web dynamics near these structures. These impacts would likely be permanent or remain as long as the structure remains. However, Atlantic sturgeon generally prefer to forage on the polychaete worms and isopods associated with soft bottom habitat, which is abundantly available in the region. The effects of habitat conversion and loss are discussed in Section 5.5.2.

These increased fish aggregations may increase fishing activities (both commercial and recreational) in the vicinity of structures. Damaged and lost fishing gear caught on structures may result in ghost fishing[10] or other disturbances, potentially leading to finfish mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as the structures are present. While

[10] *Ghost fishing* refers to entrapment, entanglement, or mortality of marine life in discarded, lost, or abandoned fishing gear, which can also smother habitat and act as a hazard to navigation.

secondary entanglement risks resulting from marine debris (e.g., derelict commercial fishing gear) is not subject to BOEM's marine debris reporting and recovery requirements, BOEM proposes a monitoring condition that would help monitor for any potential debris around WTG foundations. Monitoring, identification, and reporting of debris not associated with the Proposed Action will provide valuable information to assess if such risks are present so appropriate actions may be taken. The BOEM proposed measure BA-31 (Table 3.3-2) would require the Lessee to survey ten different WTGs annually via underwater imagery or divers to determine the frequency and locations of marine debris. Surveys will collect associated data on location, pile identification number, images, videos, disposition of located debris (removed or left in place), and any animals sighted and submit to BOEM in an annual report. In addition, best management practices will be coordinated with NOAA's marine debris program.

The effects of the presence of structures on fish movements and migrations are not yet known (Sparling et al. 2020). However, there is some evidence that offshore wind structures may create stopover locations for migratory fishes (Rothermel et al. 2020). Stopover locations may benefit migrating ESA-listed fish species by providing feeding opportunities but may also disrupt or slow migrations (Rothermel et al. 2020). Behavioral effects may alter the movements of individual fish, but they are not expected to have broad impacts on Atlantic sturgeon migration; Atlantic sturgeon carry out portions of their life history in rivers and 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 (Krebs, Jacobs, and Popper 2012), thus, the spacing between the Project WTGs would be sufficient to allow ESA-listed Atlantic sturgeon to utilize habitat between and around structures for foraging, resting, and migrating as needed.

Given that any effects on migratory deviations would be too small to be meaningfully measured or detected, the small scale of changes in the context of available habitat in the region, and the monitoring efforts proposed to alleviate entanglement risk, the effects of the presence of structures are not expected to result in measurable changes in entanglement, foraging opportunities, or migratory patterns for Atlantic sturgeon, and will be **insignificant**. Therefore, the physical presence of structures in the Project area during operations **may affect**, **not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.8 Electromagnetic Fields and Heat from Cables

The Proposed Action would include installation of up to 1,179 miles (1,897 kilometers) of export cables and 497 miles (800 kilometers) of interarray cables, increasing the production of EMF and heat in the Action Area. To reduce any potential effects from EMF and heat from underwater cables, SouthCoast Wind would bury cables to a target burial depth of 6 feet (~2 meters) wherever possible and use cable shielding materials. Possible burial depth ranges below level seabed are 3–13 feet (1–4 meters) along the ECCs and 3–8 feet (1–2.5 meters) for the interarray cables (Table 3.1-2). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized.

5.5.8.1 Marine Mammals

Marine mammals can detect magnetic field gradients of 0.1 percent of the Earth's magnetic field (i.e., approximately 0.05 microtesla) (Kirschvink 1990). Based on this sensitivity, marine mammals are likely very sensitive to minor changes in magnetic fields (Walker et al. 2003) and may react to local variation in geomagnetic fields associated with cable EMFs. These variations could result in short-term effects on swimming direction or migration detours (Gill et al. 2005). However, no EMF impacts on marine mammals associated with underwater cables have been documented.

SouthCoast Wind modeled EMF levels from 60-Hz AC cables that could be generated by submarine and onshore export cables in the Project area (Appendix P1, SouthCoast Wind 2023). The model estimated induced magnetic field levels from Project cables ranging from 85 milligauss for buried cables (6.6-foot

[2-meter] burial depth) to 1,859 milligauss for unburied cables with cable protection (1-foot-thick [0.3-meter-thick] concrete mattress) (COP Volume 1 and Appendix P1, Table 3.3; SouthCoast Wind 2023). At a distance of 10 feet from the cable center line, modeled EMF levels rapidly decline to 28.8 milligauss and 41.9 milligauss for buried and unburied cables, respectively. Reviews and analyses on potential EMF effects from offshore renewable energy projects (CSA Ocean Sciences Inc. 2021; Normandeau et al. 2011) and studies on the effects of EMF on marine organisms (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense low-intensity EMF generated by the HVAC power transmission cables commonly used in offshore wind energy projects. Normandeau et al. (2011) concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss. The 50-milligauss detection threshold is theoretical, conservative, and an order of magnitude lower than magnetic field strengths that have been found to induce behavioral responses in marine mammals (Normandeau et al. 2011). Based on EMF modeling results (COP Volume 1 and Appendix P1, Table 3.3; SouthCoast Wind 2023), marine mammals would only encounter detectable EMF (>50 milligauss) within 10 feet of either buried or unburied AC cables, and effects of any detection are unlikely. Further, marine mammals in the Project area would likely be transiting or foraging and are not expected to spend significant time on the seafloor in proximity to the interarray and export cables, reducing potential EMF exposure.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters away (Taormina et al. 2018). No data is available on cable heat effects on marine mammals (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms that serve as prey for fish species that forage in the benthos, consequently impacting piscivorous marine mammals. Based on the narrow width of the cable corridors and estimated area of thermal radiation, impacts on benthic organisms are not expected to be regionally significant (Taormina et al. 2018) and would be limited to a small area around the cables. Considering the anticipated cable burial depths, thermal effects are not expected to occur at the surface of the seabed. Therefore, any effects on marine mammal prey availability would be too small to be detected or meaningfully measured.

Given the low field intensities involved, the probable lack of interaction between ESA-listed marine mammals and the benthos in the Project area, and measures to bury cables and/or install cable surface protection, any EMF effects on marine mammals and their prey are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. Therefore, the effects of EMF from the Project **may affect, not likely to adversely affect** ESA-listed marine mammals**.**

5.5.8.2 Sea Turtles

Sea turtles can detect magnetic fields though the threshold for inducing behavioral responses varies among species. Normandeau et al. (2011) reported that loggerhead sea turtles exhibited responses to field intensities ranging from 0.0047 to 4,000 microtesla (0.047 milligauss to 40,000 milligauss) while green sea turtles have responded to field intensities ranging from 29.3 to 200 microtesla (293 to 2000 milligauss). Other species are expected to have similar thresholds due to similar anatomical features, behaviors, and life history characteristics. Juvenile and adult sea turtles may detect EMFs when foraging for benthic prey or resting on the bottom near export and interarray cables. No data is currently available on the effects of EMF associated with underwater cables on sea turtles. Migratory disruptions have been documented in sea turtles with magnets attached to their heads (Luschi et al. 2007), but there is no evidence that EMF associated with offshore wind activities would result in deviations from direct migration routes (Snoek et al. 2016). Any deviations are expected to be minor (Normandeau et al. 2011), and any increased energy expenditure due to these deviations would not be biologically significant. To reduce any potential effects from EMF and heat from underwater cables, SouthCoast Wind would bury cables to a target burial depth of 6 feet (1.8 meters) wherever possible. In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. Any potential impacts on ESA-listed sea turtles from EMF associated with the Proposed Action are expected to be too small to be detected or meaningfully measured.

The available evidence indicates that sea turtles are magnetosensitive and orient to the Earth's magnetic field for navigation but are unlikely to detect magnetic fields below 50 milligauss (5 microtesla) (Normandeau et al. 2011). Normandeau et al. (2011) further summarized theoretical concerns in the literature that anthropogenic EMF could disrupt adult sea turtle migration to and juvenile migration from nesting beaches; however, nesting beaches are not present near the parts of the Action Area where cables will be installed. Although the Proposed Action would produce magnetic field effects above the 50 milligauss detection threshold, a sea turtle would have to be within 10 feet of either a buried or unburied AC cable with cable protection to detect any EMF above 50 milligauss. Given the low densities of sea turtles in the Project area, the limited field strength involved, and limited potential for highly mobile species like sea turtles to encounter field levels above detectable thresholds, any disruptions to the navigational cues and migratory behavior of ESA-listed sea turtles are very unlikely to occur and are, therefore, **discountable**.

Magnetic fields associated with the operation of energy transmission lines could also impact benthic organisms that serve as sea turtle prey. Opportunities to effectively forage for fish, jellyfish, copepods, and krill are extremely unlikely to be affected given the limited distance into the water column that any magnetic field associated with the transmission line is detectable. The survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Bochert and Zettler 2006; Normandeau 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 several 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 (NMFS 2021). Therefore, any effects from EMF leading to the reduction on sea turtle prey and prey availability would be too small to be detected or meaningfully measured.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters away (Taormina et al. 2018). No data is available on cable heat effects on sea turtles (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms which serve as prey for sea turtles that forage in the benthos. Based on the narrowness of cable corridors and estimated area of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cables. Considering the anticipated cable burial depths, thermal effects are not expected to occur at the surface of the seabed where benthic-feeding sea turtles would forage.

Based on the analysis above and measures to bury cables and/or install cable surface protection, any potential impacts from EMF associated with the Proposed Action on sea turtles and their prey are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. Thus, the effects of EMF from the Project **may affect, not likely to adversely affect** ESA-listed sea turtles**.**

5.5.8.3 Fish

During operation, powered transmission cables would produce EMFs though the strength of the EMF rapidly decreases with distance from the cable (Taormina et al. 2018). The scientific literature provides some evidence of responses to EMFs by fish and mobile invertebrate species (Hutchison et al. 2018; Taormina et al. 2018; Normandeau Associates, Inc. et al. 2011), although recent reviews (CSA Ocean Sciences, Inc. and Exponent 2019; Gill and Desender 2020; Albert et al. 2020) indicate the relatively low intensity of the EMF associated with marine renewable projects would not result in impacts. Effects of

EMF may include interference with navigation, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). Electromagnetic-sensitive species (e.g., sharks, rays) have been shown to respond to HVAC cables, but adverse consequences have not been established (Gill et al. 2012). EMF from AC cables is not expected to adversely affect commercially and recreationally important species in the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019), and studies have shown that EMF would not interfere with movement or migration of marine species (Kavet et al. 2016).

A review of responses to DC cable EMF reported a lack of conclusive evidence supporting whether observed behavioral responses are indicative of potential population-level detrimental impacts (COP Appendix P2; SouthCoast Wind 2023). The report also finds inconsistent evidence of behavioral effects in some marine species, which are likely attributed to species-specific and life stage-related responses. A recent study (Hermans et al. 2024) evaluated the species and life stage sensitivity risks to EMF of six common benthic elasmobranchs (e.g., rays, skates, and sharks) in the Dutch North Sea. The study found that the severity of impact varies depending on the biological and ecological traits of each species group, including residency or migratory behavior and reproductive strategies (i.e., oviparous or ovoviviparous/viviparous). For embryos and eggs exposed to EMF, the severity of impact is high with the potential for deformities or reduced swimming behavior. Similarly, migratory species face a high risk of experiencing deviations off course or migration delays due to EMF exposure. Although uncertainties remain regarding the spatial range of foraging activities and local habitat preferences for these species, it is probable that EMF disturbances could disrupt predator-prey dynamics, particularly for species that forage near the seabed or those that feed on prey, such as crustaceans, influenced by EMF.

While the amplitude of EMF generated by DC cables can be up to three times greater than that of AC cables (Hutchison et al. 2020), AC and DC EMFs differ in the way they interact with organisms and direct comparisons cannot be made (CSA Ocean Sciences, Inc. and Exponent 2019). However, previous studies on DC undersea cables showed only temporary alterations in mobility and behavior of some fish species with no appreciable effects on overall movement or population health (Klimley et al. 2017; Wyman et al. 2018). Research conducted by Klimley et al. (2017) at the Trans Bay DC undersea cable near San Francisco, California, found that migration success and survival of chinook salmon and green sturgeon was not impacted by the cable EMF although temporary alterations in behavior were observed. Salmon appeared to linger at the activated cable, while migration time for sturgeon increased or decreased depending on the direction of migration. While DC undersea power cables resulted in altered patterns of fish mobility, these changes were temporary and did not interfere with migration success. In a more recent study at the Trans Bay DC undersea cable, Wyman et al. (2023) compared the movement patterns and migration success of adult green sturgeon in relation to an energized versus non-energized cable. The study reported that when the cable was energized, transit times for outbound migration took longer compared to inbound migration. However, the study also noted that while cable status (energized vs non-energized) had some predictive power on migration behavior, it did not reach statistical significance. Furthermore, the study proposed that responses based on cable properties or configurations and repeated or chronic exposures to EMF should instead be considered as these factors could potentially exert more pronounced effects on movement patters or migrations. Love et al. (2016) also conducted a series of surveys between 2012 and 2014 to track fish populations at both energized and unenergized submarine cables off the California coast. These studies were designed to assess whether EMF produced by the energized cable had any *in situ* effects on the distribution of marine species. Over three years of observations, no differences in fish communities at energized and unenergized cable sites were noted, indicating that EMF had no effect on fish distributions. CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling finfish and invertebrates residing within the southern New England area.

Although demersal biota would be most likely to be exposed to the EMF from power cables, potential exposure would be minimized because EMF quickly decays with distance from the cable source (CSA Ocean Sciences, Inc. and Exponent 2019). Project-specific modeling confirmed that EMFs diminished rapidly at a lateral distance of 10 to 25 feet (3 to 7.6 meters) from the center of the cable. (COP Appendix P1; SouthCoast Wind 2023). In the case of mobile species, an individual exposed to an EMF would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to an EMF would influence the impacts of future exposure. To reduce any potential effects from EMF and heat from underwater cables, SouthCoast Wind would bury cables to a target burial depth of 6 feet (1.8 meters) wherever possible, which would minimize the strength of the EMF in the water column and cables would have industry standard electric shielding. Therefore, any potential impacts on ESA-listed fish species from EMF associated with the Proposed Action are expected to be too small to be meaningfully measured.

As described in Section 5.5.8.2, buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters, but impacts on benthic organisms are expected to be insignificant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths and additional cable protection, such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth, thermal effects would not occur at the surface of the seabed where Atlantic sturgeon forage nor would it be expected to extend to any appreciable effect into the water column. Therefore, any thermal effects on the Atlantic sturgeon or prey species would be too small to be detected or meaningfully measured and are, thus, **insignificant**.

Overall, while EMF is detectable for sensitive fish species, the effects are localized and do not appear to present a barrier to movement. Thus, given the range of baseline variability and limited area of detectable EMF effects relative to the available habitat on the OCS, any effects from EMF exposure are considered to be non-measurable and **insignificant**. Therefore, the effects of EMF from the Project **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.9 Lighting and Marking of Structures

Vessels and offshore structures associated with offshore wind activity would have deck and safety lighting, producing artificial light during the construction, O&M, and decommissioning phases of the Proposed Action. Additional lighting for night operations may be necessary within the Lease Area and ECCs during construction and decommissioning. As discussed in Section 3.1.2, during transit and nighttime/low-visibility conditions, vessels would, at minimum, use navigation and deck lighting as required by the USCG and other applicable agencies and permit approval conditions, as necessary. SouthCoast Wind does not anticipate utilizing continuous lighting on the WTGs at the water's surface; however, SouthCoast Wind does plan to illuminate, at a minimum, the landing during crew transfers (specifically, the Walk to Work gate). The gangway from operations vessels will be fitted with necessary lighting that meets minimum requirements to assure safe transfers of technicians. The placements and intensity of lighting will be determined utilizing the API14F, EN 12464 or equivalent standard (FAA, IALA, USCG, and BOEM) such that the lighting scheme provides safe illumination for personnel and minimizes direct and/or indirect lighting of the water surface and/or surrounding environment to the extent practicable. Vessels will be illuminated to provide safe, working conditions for personnel, as dictated by the operations ongoing at that time. These operations include installation and removal of WTGs, OSPs, interarray cables, and export cables. During construction, continuous nighttime vessel lighting and construction area lighting would be required at the offshore location where the vessel and personnel are working. Work lights are generally directed downwards onto the required work area, be it a vessel deck, cranes, monopile, WTG, OSP, or other facility, to provide required illumination for personnel or ongoing operations. During O&M, SouthCoast Wind will utilize lighting during operations as required by the USCG, FAA, and/or relevant regulatory body and abide by all applicable standards.

This includes lighting to be placed on all offshore structures that will be visible throughout a 360-degree arc to aid in mariner navigation. SouthCoast Wind will implement an ADLS, which will activate the lighting system on WTGs based on approaching air traffic. Offshore structures would have yellow flashing navigational lighting and red flashing FAA hazard lights, in accordance with BOEM's (2021c) lighting and marking guidelines. Following these guidelines, direct lighting would be avoided, and indirect lighting of the water surface would be minimized to the greatest extent practicable.

5.5.9.1 Marine Mammals

Lighting is not expected to have direct effects on marine mammals. However, artificial light may indirectly impact marine mammals by disrupting the diel vertical patterns in zooplankton and fish, influencing prey location and density, and altering foraging behavior (Depledge et al. 2010; Gliwicz 1986; Orr et al. 2013). Blue whales, fin whales, NARW, and sei whales are thought to feed at night (Víkingsson 1997; Baumgartner et al. 2003; Baumgartner and Fratantoni 2008; Guilpin et al. 2019). Sperm whales also forage at night but are expected to feed in deeper waters outside the Project area. While the effects of artificial lighting on marine mammals themselves are largely unknown, impacts are anticipated to be negligible if appropriate design techniques and uses are employed (Orr et al. 2013). SouthCoast Wind would light WTGs and OSPs in compliance with FAA and USCG standards and BOEM guidelines and would avoid intentionally illuminating the water surface. SouthCoast Wind has additionally proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures associated with the Proposed Action. The effects of Project-associated lighting on marine mammals and their prey are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. The effects of lighting of vessels and offshore structures associated with the Proposed Action **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.9.2 Sea Turtles

The flashing lights on offshore structures associated with the Proposed Action are unlikely to disorient juvenile or adult sea turtles, as they do not present a continuous light source (Orr et al. 2013). However, lighting on vessels and offshore structures could elicit attraction, avoidance, or other behavioral responses in sea turtles. In laboratory experiments, juvenile loggerhead sea turtles consistently oriented toward lightsticks of various colors and types used by pelagic longline fisheries (Wang et al. 2019), suggesting that other hard-shelled sea turtle species expected to occur in the vicinity of the Projects (i.e., green or Kemp's ridley) could be attracted to offshore light sources. In contrast, juvenile leatherback sea turtles failed to orient toward or oriented away from lights in laboratory experiments (Gless et al. 2008), indicating that this species may not be attracted to offshore lighting.

There is no evidence that lighting on oil and gas platforms in the Gulf of Mexico, which may have considerably more lighting than offshore WTGs, has had any effect on sea turtles over decades of operation (BOEM 2019a). Any behavioral responses to offshore lighting are expected to be localized and temporary. SouthCoast Wind would light WTGs and OSPs in compliance with FAA and USCG standards and BOEM best practices and would avoid intentionally illuminating the water surface. SouthCoast Wind has additionally proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures associated with the Proposed Action. The effects of Project-associated lighting on sea turtles are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. Therefore, effects of lighting of vessels and offshore structures associated with the Proposed Action **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.9.3 Fish

Artificial lighting could elicit temporary attraction, avoidance, or other behavioral responses in some finfish, potentially affecting distributions near the light source. Atlantic sturgeon are demersal and forage on benthic prey. Therefore, neither the species nor its prey are likely to be exposed to artificial light associated with the Proposed Action. Based on the habitat used by ESA-listed fish species and the measures in place to reduce artificial lighting of the water surface, lighting effects on Atlantic sturgeon are extremely unlikely to occur and are thus **discountable**. Therefore, the effects of lighting of structures from the Project **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.10 Offshore Substations

The Proposed Action includes the installation and operation of up to five OSPs in the Lease Area. Potential impacts associated with impact pile driving and vessel traffic during foundation installation and with the habitat effects due to the presence of the structures are discussed in previous sections. The potential effects of offshore stations related to cooling water withdrawals, thermal discharge, and impacts on prey species are discussed in this section.

SouthCoast Wind has proposed the use of one or more HVDC converter OSPs, which would require seawater to be pumped into a cooling water intake system (CWIS) to cool the electrical equipment and then discharge back into the ocean. As described in Section 3.1.2.2, SouthCoast Wind has selected and filed a NPDES permit application (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A) for one HVDC converter OSP for Project 1. The analysis presented in the following sections is largely based on the information contained in the NPDES permit application for a single HVDC converter OSP. If SouthCoast Wind chooses to develop an additional HVDC converter OSP for Project 2, the parameters and modeling results from the NPDES permit application for Project 1 would be representative of the additional HVDC converter OSP, which would be located in the southern portion of the Lease Area.

Potential impacts associated with HVDC converter OSPs include impingement of fish, entrainment of planktonic life stages of fish and invertebrate species, temperature changes at the heated effluent discharge site, and the use of anti-biofouling treatments on the system.

5.5.10.1 Water Withdrawal and Discharge

As reported in the SouthCoast Wind Offshore Converter Station NPDES Permit Application (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A) and outlined in Table 3.1-5, the HVDC converter OSP for Project 1 would include three 28-inch (0.7-meter)-diameter vertical-shaft intake caissons, with flared ends to accommodate intake velocity requirements. The CWIS is designed to withdraw water at a depth of 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above and perpendicular to the seafloor. This mid-water column intake depth minimizes biofouling and entrainment impacts as it avoids the higher concentrations of buoyant ichthyoplankton that inhabit surface waters (Sundby and Kristiansen 2015) and those planktonic taxa associated with benthic habitats (Kendall and Naplin 1981). Each seawater intake caisson is fitted with a 3/8-inch (9-millimeter) pump strainer outer screen, a flowline filter (typical mesh size of 250 micrometers), and a stainless steel bar rack fixed to the bell mouth opening with bars spaced 6 to 10 inches (15 to 25 centimeters) apart to minimize entrapment of debris or marine organisms.

The CWIS is expected to withdraw cooling water from the ocean in the immediate vicinity of the HVDC converter OSP at rate of up to 9.9 million gallons per day (MGD) and maintain an intake velocity of 0.5 feet per second (0.15 meters per second) or less. The USEPA considers intake velocities of 0.5 feet per second (0.15 meters per second) or less a suitable compliance option to minimize impingement impacts. The design calls for a once-through cooling system because closed-cycle cooling is not a feasible option offshore. Since impingement compliance is obtained through meeting the 0.5 feet per second (0.15 meters per second) velocity requirement, and there are no traveling screens on which a fish could become impinged, potential impingement impacts due to HVDC converter intake is discountable and will no longer be discussed in the subsequent sections.

SouthCoast Wind modeled thermal plumes from the HVDC cooling water discharge to evaluate the spatial extent of the rise in temperatures of the receiving water in the vicinity of the discharge location based on the highest temperature differences between ambient (intake) and effluent (discharge) conditions in the fall (Scenario 1), winter (Scenario 2), spring (Scenario 3), and summer (Scenario 4) using a thermal mixing zone analysis in CORMIX v12.0GTD Advanced Tools. CORMIX is a recommended tool in the evaluation of point source discharges to receiving waters that also incorporates an analysis of mixing zone dynamics (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A). The plume dynamics were evaluated during four separate seasons to determine potential zones of initial dilution during those periods. According to the USEPA's Criterion Continuous Concentration for temperature-based water quality, the maximum acceptable increase in weekly average temperature resulting from artificial heat sources is 1.8°F (1°C) during all seasons of the year (USEPA 1986). Furthermore, the radius requirement for the 1.8°F (1°C) temperature increase caused by a discharge within the predicted zone of initial dilution should be less than 330 feet (100 meters) as described in the Ocean Discharge Criteria at §125.121I (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A).

From four modeled maximum temperature delta scenarios (Table 5.5-2), the distance from the discharge point where the temperature delta reached 1°C (1.8°F) was 41.9 feet (12.8 meters) in the fall, 84.9 feet (25.9 meters) in the winter, 67.5 feet (20.6 meters) in the spring, and 46.6 feet (14.2 meters) in the summer. The effluent plume area was highest in the winter at 792.1 square feet (73.6 square meters) and lowest in the fall at 407.0 square feet (37.8 square meters). These CORMIX results indicate that impacts to the ocean temperature are localized and minimal when the maximum temperature increases occur and that the water quality standard allowed for by the Ocean Discharge Criteria is expected to be met well within the 100-meter (330-foot) radius mixing zone for initial dilution of discharges (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A).

Table 5.5-2. CORMIX results for maximum temperature delta scenarios for a SouthCoast Wind HVDC OSP modeled in the Atlantic Ocean

Parameter	Scenario 1: Fall	Scenario 2: Winter	Scenario 3: Spring	Scenario 4: Summer
Maximum discharge temperature, °F (°C)	86 (30)			
Minimum Ambient Atlantic Ocean temperature, lowest seasonal observed, °F (°C)	54.1 (12.3)	39.6 (4.2)	38.6 (3.7)	51.3 (10.7)
Maximum Temperature Delta, °F (°C)	31.9 (17.7)	46.4 (25.8)	47.4 (26.3)	34.7 (19.3)
Resulting Atlantic Ocean temperature at the edge of the plume, °F (°C)	55.9 (13.3)	41.4 (5.2)	40.4 (4.7)	53.1 (11.7)
Thermal Plume Length[1], ft (m)	41.9 (12.8)	84.9 (25.9)	67.5 (20.6)	46.6 (14.2)
Thermal Plume Width, ft (m)	11.8 (3.6)	11.1 (3.4)	12.8 (3.9)	28.7 (8.7)
Plume Area, ft^2 (m^2)	407.0 (37.8)	792.1 (73.6)	721.2 (67.0)	657.1 (61.0)

[1]Distance from the outfall, where the temperature delta reaches 1°C (1.8°F)
°C = degrees Celsius ; °F = degrees Fahrenheit; ft = feet; ft^2 = square feet; m = meters; m^2 = square meters
Source: Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A

Bleach (sodium hypochlorite) would be used to inhibit marine growth in the HVDC cooling equipment. A hypochlorite generator would produce the bleach by seawater electrolysis. These generators are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 parts per million equivalent free chlorine concentration in the seawater intake lines (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A). This concentration is small and is equivalent to 0.0002 percent per unit volume. Residual free chlorine within discharged effluent would be negligible and oxidized in the water with no negative impact on any marine species.

5.5.10.1.1 Marine Mammals

During operation, there would be increased intake and discharge from HVDC converter OSP(s) in the Lease Area, which requires continuous cooling water withdrawals and subsequent discharge of heated effluent back into receiving waters. Marine mammals would not be at risk for entrapment or impingement but could experience indirect effects during water withdrawals if their prey species become entrained in very large numbers (as discussed further in Section 5.5.10.2.1).

In addition to secondary impacts, the HVDC converter OSP would discharge warmer water into the surrounding ocean, which could potentially have localized impacts on marine mammals. As shown in Table 5.5-2, the CORMIX modeling results indicate the greatest distance reached by the thermal plume was 84.9 feet (25.9 meters) and occurred during winter. The effluent plume area was also largest in winter, reaching a maximum of 792.1 square feet (73.6 square meters). Potential thermal effects from cooling water discharge at the HVDC converter OSP would not be expected to affect ESA-listed marine mammals due to the small discharge plume and localized temperature increase within the mixing zone in comparison to larger CWIS at other coastal facilities. Similar results would be anticipated if SouthCoast Wind selects an additional HVDC converter OSP for the southern portion of the Lease Area for Project 2.

Based on the analysis above, the ecological effects from thermal discharge and discharged effluent from HVDC converter OSP(s) are expected to be minimal and extremely localized. Further, marine mammals are not at risk for entrainment, nor do they have juvenile life stages that are susceptible to entrainment. Therefore, the potential effects from the operation of HVDC converter OSP(s) and associated CWIS intake and discharge are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant.** Thus, water withdrawals and discharges from offshore substations **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.5.10.1.2 Sea Turtles

As discussed previously, the Proposed Action would install one or more HDVC converter OSPs, which would result in the intake and discharge of water. There is potential for entrapment of sea turtles within the vertical intake pipes of the CWIS, based on historical evidence of entrapment in cooling water intakes at other facilities. Sea turtles, especially smaller or less mobile individuals, in the vicinity of the OSPs could be entrapped within intake pipes of the CWIS. Records of sea turtles becoming trapped within cooling water intakes from power plants have been common, though incidents are primarily located in warmer regions where sea turtles are likely to occur year-round and in higher-volume cooling water systems (e.g., those of nuclear power plants) (Florida Power and Light, 1995; Florida Power Corporation, 1998). While the likelihood of sea turtle entrapment is low due to the seasonal nature and overall low sea turtle abundance in Project area waters (see Section 4.9.2.2), mitigation measures proposed to reduce overall entrapment (e.g., intake velocity of 0.5 feet per second [0.15 meters per second] and appropriately sized bar racks) are expected to minimize these risks further. Bar racks with spacings 6 to 10 inches (15 – 25 centimeters apart) are under consideration; however, SouthCoast Wind is currently in the preliminary design stage and will consult with USEPA and NMFS to ensure that the final engineering design and spacing of the bar racks are appropriate and protective to marine organisms to minimize the overall risk of entrapment at the CWIS.

The thermal plume created by effluent from cooling water discharge may also affect sea turtles occurring near the OSPs. Behavioral and biological impacts of heated effluent from cooling water discharges have been studied but are not well understood. Research suggests green sea turtles may use plumes from cooling water effluent as thermal refuge or foraging habitat, potentially resulting in extended residence times in areas outside natural movement or migratory periods (Crear et al. 2016; Turner-Tomaszewicz and Seminoff 2012). Green sea turtles inhabiting areas downstream of warm effluent have also been observed to have increased growth rates relative to other individuals in similar regions (Eguchi et al., 2012). It may be unlikely for sea turtles to experience these thermal impacts from SouthCoast Wind cooling operations due to the small size of the discharge plume and extremely localized temperature increase within the mixing zone in comparison to other larger CWISs at coastal facilities.

Given the very low abundance of sea turtles in the Project area, there is a low likelihood of entrapment in the HVDC converter OSPs and intake pipes. To reduce the overall risk of entrapment at the CWIS, the final bar rack spacing currently being considered will be further refined based on ongoing consultations with USEPA and NMFS. The associated thermal discharge is also expected to be extremely localized, and the overall effects are so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. Therefore, the installation and operation of HVDC converter OSP(s) and associated CWIS intake pipes **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.10.1.3 Fish

Impacts of entrainment on finfish and planktonic larvae at HVDC converter intake locations are expected to be limited to the immediate area around an OSP. While adult and late-juvenile stages of the Atlantic sturgeon move between coastal and offshore marine environments (Bain 1997, Ingram et al. 2019), its occurrence in the Lease Area is rare where the HVDC converter OSP(s) are located, thus, the risk of interaction at the CWIS is low. Further, impingement of adult Atlantic sturgeon is considered improbable given the expected CWIS intake configuration (e.g., intake velocity not exceeding 0.5 feet per second (0.15 meters per second); equipped with appropriately sized bar rack; no traveling screens; Table 3.1-5) and planned entrainment mitigation measures (e.g., single pump operation, use of variable frequency drives) during operation of SouthCoast Wind’s offshore HVDC converter OSP(s).

As the HVDC converter OSP would discharge warmer water into the surrounding ocean, thermal discharge could have localized impacts on Atlantic sturgeon. Atlantic sturgeon rely on temperature cues throughout important life stage events such as migration, spawning, and juvenile dispersal (Gilbert 1989). The impact of raised water temperatures on living organisms is most frequently seen in the lowered dissolved oxygen saturation level of warmer water since dissolved oxygen levels are often a limiting factor for organism survival (Mel’nichenko et al. 2008). A laboratory experiment investigating the impact of temperature, salinity, and dissolved oxygen levels on juvenile Atlantic sturgeon found that optimal growth and food intake occur above 70 percent oxygen saturation at 20°C (68°F). Survival increases with oxygen saturation but decreases at higher temperature and salinity levels (Niklitschek and Secor 2009). SouthCoast Wind modeled thermal plumes of the discharged cooling seawater from the HVDC converter OSP for Project 1, as described above in Section 5.5.10.1. Based on modeling results, impacts on water temperature from heated effluent discharge are expected to be localized and minimal (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A). To experience direct effects from thermal discharge, an Atlantic sturgeon would need to be within 84.9 feet (25.9 meters) of the discharge point or within the 792.1 square feet (73.6 square meters) of the effluent plume. Although Atlantic sturgeon may avoid the HVDC converter OSP(s), it is anticipated that their foraging and migration abilities would remain unaffected due to the limited area of disturbance. Similar results would be anticipated if SouthCoast Wind selects an additional HVDC converter OSP for the southern portion of the Lease Area for Project 2.

Due to the limited range of warmed water, the ability of fish to move out of the affected area, and the mitigation measures in place, the overall effects of water withdrawals and discharges at HVDC converter

OSPs are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, **insignificant**. Therefore, the operation of HVDC converter OSP(s) and associated CWIS intake pipes **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.10.2 Impacts on Prey

To provide estimates of the entrainment impact from the HVDC converter OSP for Project 1, data from the EFH mapper, MarMap/EcoMon ichthyoplankton surveys (1977–2019), and MA DMF trawl surveys were used as a proxy to determine the species and life stages most susceptible to entrainment (Tetra Tech and Normandeau Associates, Inc. 2023). Based on monthly mean larval densities of species observed within 10 miles (16 kilometers) of the CWIS location and assuming a water withdrawal rate of 9.9 million gallons per day (MGD), the taxa with the highest estimated annual larval entrainment were unspecified hake (3.9 million), Atlantic herring (3.9 million), sand lance (3.3 million), summer flounder (1.3 million), and silver hake (0.5 million). Atlantic cod were estimated to have relatively low annual larval entrainment of 85,353 individuals between January and April, with a peak of 40,734 individuals in March. While entrainment estimates were generated from the best available data, these estimates may not reflect the current species composition in the study area, seasonality, population dynamics, or natural variability due to the limitations of the data set used and given that no project-specific studies have been conducted to characterize the local composition of plankton species in the vicinity of SouthCoast Wind's proposed HVDC converter station and the susceptibility of these species to the impacts of entrainment. Furthermore, ichthyoplankton data used in this analysis were from various water column depths as opposed to the fixed depth of the CWIS intake of 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above and perpendicular to the seafloor; thus, this analysis may overestimate larval entrainment as individuals settling in demersal habitats or floating on the surface will likely not be susceptible to the CWIS intake flow. Similar results would be anticipated if SouthCoast Wind selects an additional HVDC converter OSP for the southern portion of the Lease Area for Project 2.

Entrainment minimization measures that may be used at the converter station facility include single pump operation, dual pump operation at reduced capacity via three-way valve or variable frequency drives, and a fixed depth of water withdrawal (Tetra Tech and Normandeau Associates, Inc. 2023). With the extent of entrainment being directly proportional to the intake flow volume, the likely scenario of running two pumps at 50 percent capacity reduces the cooling intake flow volume leading to a proportional reduction in entrainment levels. Variable frequency drives may be used in the CWIS to control flow and minimize the total flow volume required. This allows for the maintenance of safe operational parameters in the HVDC converter while reducing the water intake volume and entrainment impact. Water withdrawal from the middle portion of the water column may also minimize entrainment impacts compared to surface withdrawal. An entrainment study by Shaw Environmental (2006) at the Mystic Power Station in Boston Harbor found significantly higher ichthyoplankton densities at the surface compared to the water intake withdrawal depth of 7 feet (2.1 meters). By avoiding higher concentrations of entrainable ichthyoplankton found in surface waters through a CWIS water withdrawal depth of 74 feet (22.6 meters), potential entrainment impacts at the SouthCoast Wind HVDC converter station would be minimized.

To further minimize potential impacts on zooplankton from entrainment, the northernmost HVDC converter OSP will be located outside of a 6-mile (10-kilometer) buffer of the 30-meter isobath from Nantucket Shoals. In addition, a BOEM-proposed measure (NS-1, Table 3.3-2) will be implemented in the enhanced mitigation area to minimize potential impacts to prey items especially in areas with high densities of zooplankton. This measure prohibits open-loop cooling systems in the enhanced mitigation area, increasing the size of this enhanced mitigation area to extend approximately 7 – 9 miles (11 – 14.5 kilometers) southwest of the 30-meter isobath, thereby reducing the entrainment of zooplankton in the HVDC cooling system. While Project activities would not overlap with the highest modeled densities of zooplankton in the Nantucket Shoals region, this precautionary measure is expected to minimize mortality to prey species of higher trophic level animals compared to the PDE. Potential impacts to zooplankton prey from HVDC CWIS entrainment are discussed in Section 5.5.10.2.1.

In the context of regional abundances and species life histories, estimated losses of ichthyoplankton from entrainment by OSP HVDC converter platforms are small. At a water withdrawal rate of 9.9 MGD, the CWIS influences only 0.00015 percent of the total water volume in the Lease Area given an average water depth of 164 feet (50 meters) and the estimated annual entrainment losses of ichthyoplankton would represent a small proportion of regional populations. When considering the high mortality rates in early life stages of fishes, fish eggs and larvae lost to entrainment are expected to be inappreciable when compared to natural mortality rates. At this scale, and with the implementation of mitigation measures designed to reduce the impacts to prey species, the ecological effects from entrainment via the OSP intake will likely be **insignificant** for all ESA-listed species as discussed in the sections below.

5.5.10.2.1 Marine Mammals

The SouthCoast Wind CWIS may entrain various planktonic organisms, some of which may be prey species (e.g., copepods [*Calanus* spp., *Pseudocalanus* spp., *Centropages* spp.] and other zooplankton) important to the foraging base of marine mammals, such as the endangered NARW (*Eubalaena glacialis*) within the Project area. Laboratory experiments carried out to determine the effects of chlorine treatment associated with cooling water intakes on entrained copepod species found that the entrainment process typically resulted in copepod mortality due to not only the biocide treatment, but also thermal stress influenced by exposure time (Ershath et al. 2019). Melton and Serviss (2000) suggested that longer exposure durations were associated with higher mortality rates and shorter exposure durations associated with lower mortality rates. Once dead, the copepod carcass becomes less dense as it decomposes, retaining its buoyancy before slowly falling to the sea floor (NSF 2011). Within the Great South Channel off New England, a large dense patch of copepods was investigated where an area of accumulated copepod exoskeletons and partially decomposed copepods was attributed to predation of right whales feeding on an adjacent live patch of copepods (Wishner et al. 1988). In the York River estuary in Virginia, copepod carcasses were analyzed to determine how long they remained suspended in the water column before sinking to the sea floor (Elliot et al. 2010). Turbulent mixing kept carcasses suspended in the water column as microbial decomposition reduced the dry weight of the carcasses within the first eight hours after death. A comparable entrainment analysis for the cooling water intake system at the Sunrise Wind Farm offshore converter station, with an intake volume of 8.1 million gallons per day, estimated an annual entrainment of 1.1 billion individuals of *Calanus finmarchicus* (TRC 2022). This level of entrainment loss constituted less than 0.1 percent of the estimated local population of this species within the Sunrise Wind Farm Lease Area. Thus, while copepods are subject to entrainment through the CWIS, the number of copepods lost represent a small fraction of the entire population stock in the region and any individuals entrained through the intake are returned to the source water via the discharge pipe and may still remain available as prey items to the NARW and other marine organisms.

Assessing the magnitude of copepod entrainment impacts on whales may be achieved by comparison to assessments completed by other facilities that use seawater cooling systems in the region. The Northeast Gateway Offshore LNG Terminal Project offshore of Massachusetts has comparatively similar types of entrainment impacts as those that are anticipated by the SouthCoast Wind CWIS. As part of the impact assessment for the Northeast Gateway Project, Dr. Robert Kenney developed a bioenergetic model to address the impacts of the removal of zooplankton and small fish on marine mammals and whether cooling water system entrainment would remove excessive biomass of prey beyond natural variability and recovery rates. (Northeast Gateway 2012). Based on whale metabolism research by Kenney et al. (1985) and Trites and Pauly (1998), the estimated daily and annual prey consumption rates for an individual NARW are from 518 to 774 kilograms per day and 46,587 to 69,985 kilograms per year while present off the coast of Massachusetts (Northeast Gateway 2012). The Northeast Gateway Project operations were estimated to potentially remove approximately 1,700 kilograms per year of zooplankton and small fish (while utilizing up to 56 million gallons per day), which was considered a negligible volume of prey items relative to individual and population requirements of whales occurring in the region. Therefore, the SouthCoast Wind CWIS operations, which would intake considerably less cooling water of 9.9 million gallons per day compared to 56 million gallons per day at Northeast Gateway would be expected to entrain proportionally much lower numbers of prey.

Marine mammal prey may also be susceptible to thermal impacts from subsequent heated discharge effluent released back into receiving waters. However, the thermal mixing zone analysis (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A) indicated that impacts of heated effluent to the ocean temperature would be minimal due to the small discharge plume and localized minimal temperature increase. To further reduce potential impacts on zooplankton, the northernmost HVDC converter OSP will be located outside of a 10-km buffer of the 30-meter isobath from Nantucket Shoals, which is an area of high productivity and foraging value for several marine species. Further, a BOEM-proposed measure would increase the size of this enhanced mitigation area to extend approximately 7 – 9 miles (11 – 14.5 kilometers) southwest of the 30-meter isobath (NS-1 in Table 3.3-2).

Given the low proportion of potentially entrained prey items, the small and localized effects from thermal discharge, and the applicant- and agency-proposed mitigation measures in place, OSP operations are not expected to make any measurable impacts to prey availability and are considered **insignificant**. Therefore, the installation and operation of HVDC converter OSP(s) and associated CWIS intake pipes **may affect, not likely adversely affect** marine mammal prey.

5.5.10.2.2 Sea Turtles

Sea turtle prey may be susceptible to entrainment. The CWIS is designed to withdraw water at a depth of 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above the seafloor. This mid-water column intake depth would minimize potential entrainment impacts as it avoids prey items that inhabit surface waters and those associated with benthic habitats. However, pelagic prey that are found throughout the water column, such as salps and jellyfish, may still be susceptible to entrainment. To reduce potential impacts on these prey items, the northernmost HVDC converter OSP will be located outside of a 6-mile (10-kilometer) buffer of the 98-foot (30-meter) isobath from Nantucket Shoals, an area of high foraging value for several marine species. Further, a BOEM proposed measure would increase the size of this enhanced mitigation area to extend approximately 7 – 9 miles (11 – 14.5 kilometers) southwest of the 30-meter isobath (NS-1 in Table 3.3-2). Sea turtle prey may also be susceptible to thermal impacts from subsequent heated discharge effluent released back into receiving waters. However, the thermal mixing zone analysis (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A) indicated that impacts of heated effluent to the ocean temperature would be minimal due to the small discharge plume and localized minimal temperature increase.

Given the CWIS depth of withdrawal, the small and localized effects from thermal discharge, and the application of mitigation measures to reduce entrainment, OSP operations are not expected to make any measurable difference in sea turtle foraging and prey availability; thus, effects will be **insignificant**. Therefore, the installation and operation of HVDC converter OSP(s) and associated CWIS intake pipes **may affect, not likely adversely affect** sea turtle prey.

5.5.10.2.3 Fish

The Atlantic sturgeon is a bottom feeder and typically feeds on crustaceans, worms, and mollusks. As the CWIS is designed to withdraw water from the middle of the water column at a depth of 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above the seafloor, prey items associated with benthic habitats would not be at risk to entrainment.

Atlantic sturgeon prey may also be susceptible to thermal impacts from subsequent heated discharge effluent released back into receiving waters. However, the thermal mixing zone analysis (Tetra Tech and Normandeau Associates, Inc. 2023; Appendix A) indicate that impacts of heated effluent to the ocean temperature would be minimal due to the small discharge plume and localized temperature increase.

Due to the depth of water withdrawal and the small and localized effects from thermal discharge, OSP operations are not expected to make any measurable difference in foraging and prey availability and thus effects are expected to be **insignificant**. Therefore, the installation and operation of HVDC converter OSP(s) and associated CWIS intake pipes **may affect, not likely adversely affect** prey availability of ESA-listed Atlantic sturgeon.

5.5.11 Entrainment from Suction-Bucket Installation

SouthCoast Wind may use suction-bucket jacket foundations for up to 85 wind turbine generators (WTG) in the southern portion of Lease Area (Figure 3.1-5). Each suction-bucket jacket foundation will be made up of four buckets (one per leg) with each bucket having a diameter of up to 65.6 feet (20 meters), a penetration depth of up to 65.6 feet (20 meters), and a volume of approximately 8,894 cubic yards (6,800 cubic meters). Suction bucket jacket installation is scheduled to occur over a 16-month period between the start of Q2 2030 (April 2030) to the start of Q3 2031 (July 2031). During installation of suction-bucket jacket foundations, planktonic organisms may become entrained as water is pumped out of the buckets during the embedding process. An entrainment assessment was conducted to estimate the potential impact this construction activity may have on zooplankton and ichthyoplankton species present within the installation area (RPS 2024). The presence and abundance of plankton species in the SouthCoast Wind suction-bucket jacket installation area was determined using NOAA-NEFSC Ecosystem Monitoring (EcoMon) survey program plankton data (NOAA NEFSC 2019) limited to within 3.10 miles (5 kilometers) of the foundation installation area. This analysis area was used on the assumption that foundation installation is a one-time localized action with short-term entrainment impacts. Monthly entrainment estimates for suction-bucket foundation installations were calculated using a per foundation one-time total seawater displacement volume of 27,200 cubic meters (6,800 m^3 per bucket x 4 buckets per foundation), the assumption that the installation of 85 suction-bucket jacket foundations would occur evenly over a 16-month period from April 2030 to July 2031, and the taxa-specific EcoMon plankton density data averaged by month.

5.5.11.1 Impacts on Prey

A total of 91 plankton taxa were found to occur in the suction-bucket jacket entrainment analysis area of which 55 were zooplankton and 36 were ichthyoplankton (RPS 2024). Calanoid copepods, the preferred prey species of NARW, were the most abundant of the zooplankton taxa present in the entrainment analysis area. *Centropages typicus*, *Calanus finmarchicus*, *Pseudocalanus* spp., and *Temora longicornis* had the highest mean monthly densities at 132,995.40 (October), 125,988.43 (May), 56,569.62 (May), and 76,906.81(June) individuals per 100 cubic meters, respectively. Among other notable zooplankton species, salps, which are prey for sea turtles, had a peak density of 27,562.04 individuals per 100 cubic meters in October. Excluding unidentified fish (Pisces), the most abundant ichthyoplankton species were the sand lance (*Ammodytes* spp.), gulf stream flounder (*Citharichthys arctifrons*), Atlantic mackerel (*Scomber scombrus*), and hake (*Urophycis* spp.). Sand lances, a prey species for Atlantic sturgeon, fin whales, and sei whales, showed peak abundance in January with a mean density of 290.39 individuals per 100 cubic meters while gulf stream flounder, Atlantic mackerel, and hake had peak mean monthly densities of 182.80 (September), 315.67 (June), and 158.74 (August) individuals per 100 cubic meters, respectively (RPS 2024).

The highest estimated total entrainment for all ichthyoplankton and zooplankton taxa combined occurred in the months of May and June which coincided with peak abundance for Calanoid copepods and the months where the most suction-bucket jacket foundation installations occurred (RPS 2024). Entrainment estimates generally followed monthly plankton density trends given that these calculations are density dependent with the exception of April, May, June, and July where foundation installations were double that of the other months. Among zooplankton species, *C. finmarchicus* had the highest estimated entrainment at 342,688,524 individuals in the month of May. For ichthyoplankton species identified to at least genus, Atlantic mackerel had the highest estimated entrainment in the month of June at 944,475 individuals. Total estimated entrainment (number of individuals) by taxa from start to completion of suction-bucket jacket foundation installation was highest for *C. finmarchicus* (874,641,271), *C. typicus* (820,148,482), *Pseudocalanus* spp. (609,183,491) and *T. longicornis* (308,384,062) among zooplankton taxa and Atlantic mackerel (954,383), sand lance (869,447), gulf stream flounder (507,854), and hake (488,465) among ichthyoplankton taxa. In comparison to the estimated entrainment for the most abundant Calanoid copepod species, entrainment of salps was an order of magnitude less at 78,698,098 individuals in total for this construction activity (RPS 2024).

While entrainment estimates were generated from the best available data, these estimates may not reflect the current species composition in the study area, seasonality, population dynamics, or natural variability due to the limitations of the data set used and given that no project-specific studies have been conducted to characterize the local composition of plankton species in the vicinity of the suction bucket installation area and the susceptibility of these species to the impacts of entrainment. As the installation of suction-bucket jacket foundations is a one-time localized action, entrainment impacts are considered short-term and limited to the immediate vicinity of the installation activity. In a similar entrainment assessment conducted for the cooling water intake system of the Sunrise Wind Farm offshore converter station with an intake volume of 8.1 million gallons per day and an estimated annual entrainment for *C. finmarchicus* of 1.1 billion individuals, TRC (2022) reported that this magnitude of entrainment loss represented less than 0.1 percent of the estimated local population of this species in the Sunrise Wind Farm Lease Area. In comparison, plankton entrainment estimates from suction-bucket jacket installations are considerably less, would be a one-time event, and would impact an even smaller percentage of the plankton population in the vicinity of the SouthCoast Wind suction bucket foundation installation area. Therefore, the impacts associated with the entrainment of zooplankton and ichthyoplankton prey of marine mammals, sea turtles, and fish are considered **negligible**.

5.5.12 Summary of Habitat Disturbance Effects

5.5.12.1 Marine Mammals

Habitat disturbance or modifications associated with G&G surveys, dredging, and trenching would have no effect on ESA-listed marine mammals. Habitat conversion and loss associated with WTGs, OSPs, scour protection, cable emplacement, and vessel anchoring are expected to have an insignificant effect on foraging opportunities for ESA-listed marine mammals. Reef effects could increase recreational fishing activity around offshore structures which would consequently increase the risk of entanglement, however, mitigation and monitoring measures should reduce such risks. Increased turbidity associated with the Proposed Action may result in short-term localized effects on ESA-listed marine mammals, but these effects would be insignificant. The physical presence of WTGs in the Lease Area could directly affect ESA-listed marine mammals through avoidance, displacement, or behavioral disruption or indirectly through localized hydrodynamic effects on prey distribution. However, there still remains a large degree of uncertainty on the long-term impact on marine mammals due to the presence of structures and any potential effects are unlikely to be discernible from natural variability and the more pronounced impacts of climate change, thus, any such effects are considered insignificant. Effects on ESA-listed marine mammals from EMF associated with submarine cables, lighting of structures, and offshore substation water withdrawal and discharge are also expected to be insignificant. Therefore, the effects of habitat disturbance or modification from related Project activities **may affect, not likely to adversely affect** ESA-listed mammals.

5.5.12.2 Sea Turtles

Habitat disturbance associated with G&G surveys, dredging, and trenching would be short-term and localized to a small area. Therefore, associated impacts on benthic-feeding species such as loggerhead and Kemp's ridley sea turtles would be insignificant. Other ESA-listed sea turtles do not forage in soft bottom habitats and would therefore have no effect from habitat disturbances due to G&G surveys, dredging, and trenching. Habitat conversion and loss associated with WTGs, OSPs, scour protection, cable emplacement, and vessel anchoring are expected to have insignificant effects on foraging opportunities for ESA-listed sea turtles. Reef effects would increase recreational fishing activity around offshore structures and may consequently increase the risks of entanglement and vessel collision. The risk is particularly concerning for certain species such as loggerheads, which spend considerable time at or just below the surface for thermoregulation. However, the implementation of mitigation and monitoring measures would minimize such risks. Increased turbidity associated with the Proposed Action may result in short-term localized effects on ESA-listed sea turtles, but these effects would be insignificant. The physical presence of WTGs in the Lease Area could directly affect ESA-listed sea turtles through avoidance, displacement, or behavioral disruption or indirectly through localized hydrodynamic effects on prey distribution. Any direct or indirect effects associated with the presence of WTGs are expected to be insignificant for ESA-listed sea turtles. Effects on ESA-listed sea turtles and their prey from EMF and heat associated with submarine cables, lighting of structures, and offshore substation withdrawal and discharge are expected to be so unlikely as to be discountable. Therefore, the effects of habitat disturbance from related Project activities **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.5.12.3 Fish

Habitat disturbance associated dredging, trenching and G&G surveys would be short-term and localized to a small area. Therefore, associated impacts from these activities on Atlantic sturgeon would be insignificant. Habitat conversion and loss associated with WTGs, OSPs, scour protection, cable emplacement, and vessel anchoring are also expected to have insignificant effects on foraging opportunities for Atlantic sturgeon. Reef effects could increase recreational fishing activity around offshore structures and may consequently increase entanglement risk. Increased turbidity associated with the Proposed Action may result in short-term localized effects on Atlantic sturgeon, but these effects would be insignificant. The physical presence of WTGs in the Lease Area could directly affect Atlantic sturgeon through avoidance, displacement, or behavioral disruption. Any effects associated with the presence of WTGs are expected to be insignificant for Atlantic sturgeon. Effects on Atlantic sturgeon from EMF and heat associated with submarine cables, lighting of structures, and offshore substation withdrawal and discharge are also expected to be insignificant. Therefore, the effects of habitat disturbance from related Project activities **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.5.12.4 Impacts on Prey

Impacts from G&G surveys may cause benthic habitat disturbance and reduce the availability of benthic invertebrates that serve as prey for Atlantic sturgeon and Kemp's ridley sea turtles. These impacts are expected to be localized and short-term, with recolonization occurring quickly. Associated impacts would be **insignificant**. Habitat conversion due to the presence of structures is expected to lead to an increase in fish and crustacean biomass due to the reef effect of encrusting organisms colonizing the structures. This will also lead to a loss in soft bottom habitat, which may reduce the local abundance of infaunal organisms and sand lance, which are prey for Atlantic sturgeon, fin whales, and sei whales. However, the loss of soft bottom habitat would be very small compared to the amount of soft bottom habitat in the surrounding region, therefore the impacts would be **insignificant**. Turbidity can have adverse effects on suspension feeding mollusks, crustacean, and sponges, which are prey for the benthic feeding sea turtles.

The effects of suspended sediment from the Project are expected to be **insignificant** and result in negligible reductions in benthic prey species. Estimated losses of benthic organisms from dredging are expected to be small. The dredging paths are relatively narrow and are benthic-oriented, thus only benthic infauna or sessile organisms on the seafloor or near the seafloor would be impacted. Immobile life stages of fish and invertebrate species in or on benthic sediment in the direct path of the draghead would be at the most risk of direct injury or mortality. Trenching is expected to have similar impacts on prey species. At this scale, the ecological effects from loss of prey due to dredging and trenching will likely be **insignificant** for all ESA-listed species. Submarine cables may produce heat which would impact benthic and infaunal organisms in the immediate area, given the burial depths of the cables these effects would not reach the seabed surface. EMF is not expected to affect the survival of benthic organisms in the area. Effects of EMF and heat associated with submarine cables and lighting of vessels and offshore structures are therefore expected to be **insignificant.** The presence of structures in the area is likely to create hydrodynamic changes in the environment, which could lead to changes in zooplankton abundance and distribution. Impacts on zooplankton primarily affect whales, most notably the NARW, as it is an obligate feeder of copepods. Jellyfish, which are the primary prey of leatherback sea turtles, are expected to be similarly impacted by hydrodynamic change. Alterations in the plankton community will in turn influence the abundance and distribution of forage fish, which are preyed upon by fin and sei whales. Changes in primary productivity that may occur due to the presence of structures could potentially be small and not discernable from natural variations in primary productivity. Increased mixing may lead to the dispersal of plankton aggregations; however, it is also possible that wind wake effects lead to a shallowing of the mixed layer, leading to plankton concentration. The current effects are unknown. HVDC converter OSPs are expected to lead to the entrainment of plankton, including the planktonic larval stages of fish and crustaceans. *Calanus* spp. copepods, the favored prey of the NARW, is likely to be subject to entrainment. However, the rates of prey removal due to OSP operations are expected to be too small to make any measurable difference in prey availability. Similarly, estimated entrainment impacts on the zooplankton and ichthyoplankton prey of ESA-listed species from the installation of 85 suction-bucket jacket foundations were found to be minimal in comparison to local population densities. Therefore, the effects of habitat disturbance from related Project activities leading to the reduction of prey **may affect, not likely to adversely affect** ESA-listed species.

5.6 Fisheries and Habitat Surveys and Monitoring

As described in Section 3.1.2.7, SouthCoast Wind's fisheries and benthic monitoring plans (SMAST 2024, INSPIRE 2023; INSPIRE 2024) propose a variety of survey methods that evaluate the effects of construction and operations on benthic habitat structure and composition and economically valuable fish and invertebrate species. These survey methods include acoustic telemetry, drop camera, demersal trawl, ventless trap/pot, neuston net sampling, video/photography surveys, sediment grab samples, and SPI/PV. In addition to specific requirements for monitoring during the construction and operations period, HRG surveys and periodic PAM deployments may occur over the life of the Project for other scientific monitoring needs. Each component of the monitoring plan presents differential entanglement risk (Section 5.6.1) and impacts on prey species (Section 5.6.2) to ESA-listed species, as discussed below.

The proposed surveys involve similar methods to and would complement other survey efforts conducted by various state, federal, and university entities supporting regional fisheries research and management. All requirements of the Proposed Action will follow BOEM's 2021 Project Design Criteria and Best Management Practices (BOEM 2021d) to limit interactions with protected species.

5.6.1 Risk of Capture/Entanglement

5.6.1.1 Marine Mammals

Each component of the pre- and post-construction monitoring plan carries inherent risks of marine mammal entanglement. Theoretically, any line in the water column or resting on or floating above the seafloor, deployed in areas frequented by marine mammals could pose an entanglement risk (Johnson et al. 2005). Entanglements may involve the head, flippers, or fluke; effects range from no apparent injury to death. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species recovery (NMFS 2023e; Knowlton et al. 2012).

Trawl surveys to be conducted by SouthCoast Wind (SMAST 2024), will follow similar surveys for other wind farms with sampling procedures modeled after the NEAMAP for data compatibility. These tows are typically shorter in duration (20 minutes) than conventional commercial trawl tows, and less frequent for research fishing vs. commercial fishing, often spread out over a much larger area. NMFS' opinion on the *Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of a Letter of Authorization under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals pursuant to those Research Activities* (dated June 23, 2016) concluded that impacts to NARWs, humpback whales, fin whales, sei whales, and blue whales, if any, as a result of trawl gear use would be expected to be extremely unlikely to occur. Additionally, the slow speed of mobile gear (3.0 knots) further reduces the potential for marine mammal entanglements or other interactions. Observations during mobile gear use have shown that entanglement or capture of large whale species is extremely rare and unlikely (NMFS 2016b). Although the trawl methods for commercial fisheries are comparable to the fishery monitoring methods proposed, the proposed trawl effort and tow durations (20 minutes) for the proposed fisheries monitoring surveys are less than that previously considered by NMFS for commercial trawling activities. Thus, the potential for entanglement of ESA-listed marine mammals in bottom trawl equipment is, therefore, considered extremely unlikely to occur.

Large whales are vulnerable to entanglement in stationary vertical and ground lines associated with trap/pot gear, including ventless trap surveys. The Final Environmental Impact Statement, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis for Amending the Atlantic Large Whale Take Reduction Plan: Risk Reduction Rule (NOAA 2021) provides an analysis of data that show entanglement in commercial fisheries gear represents the highest proportion of all documented serious and non-serious incidents reported for humpback, NARW, fin, and minke whales. Entanglement was the leading cause of serious injury and mortality for NARW, humpback, fin, and minke whales from 2010 to 2018 for cases where the cause of death could be identified (NOAA 2021). For the proposed ventless trap survey, each trap string will contain a total of six pots, alternating between vented and ventless traps. The dimensions for all traps are standardized (40" x 21" x 16") throughout all survey areas and contain a single kitchen, parlor, and rectangular vent in the parlor of vented traps (size 1 15/16" x 5 ¾"). Ropeless fishing gear will be used in lieu of traditional downlines to reduce the risk of vertical line entanglement. The primary method for retrieving trap strings will be grappling, though on-demand systems will continue to be tested and potentially phased into the survey as the technology progresses and becomes logistically feasible. Ventless trap surveys will sample 30 random depth-stratified stations and will occur from May through October when NARW are less likely to be in the Project area. Surveys will involve two hauling periods planned per month, and gear soak time will be limited to three days after which all trap and pot gear will be hauled out. Mitigation measures outlined in Table 3.3-1 and Table 3.3-2 (BA-3) include visual monitoring for listed-species during survey operations, vessel strike avoidance measures (including vessel separation distances) similar to other project vessels, and gear-specific measures to minimize the potential for incidental capture during trawl surveys. All take reduction plans will be incorporated into survey equipment and execution for trawl surveys. All traps will be marked and survey gear will be labeled as research gear with scientific permit number. Missing gear will be reported to the NOAA Greater Atlantic

Regional Fisheries Office Protected Resources Division. Based on the applicant-proposed and agency-required risk reduction measures that will be implemented for each gear type (Table 3.3-1, Table 3.3-2), the limited gear soak time and seasonal deployments of traps, the risk of entanglement in gear to marine mammals would be extremely unlikely to occur.

Neuston net sampling involves towing a plankton net at slow speeds (4 knots) for brief periods (10 minutes) in the upper 1.6 feet (0.5 meters) of the water column. As the neuston net frame measures 7.9 x 2 x 19.7 feet (2.4 x 0.6 x 6 meter) and features a mesh size of 0.5 inch (1,320 micrometers) and deployed off the stern of the vessel, this would not pose as an entanglement risk to marine mammals. Similarly, drop camera sampling occurs directly from the vessel's stern, with continuous seabed monitoring. HRG and benthic habitat monitoring surveys avoid gear that could entangle marine mammals. Thus, the risk of entanglement from neuston net, drop camera, and benthic habitat monitoring surveys is highly unlikely and can be discounted for ESA-listed marine mammals.

Acoustic telemetry surveys will employ fixed station acoustic receivers to monitor fish presence and movement (INSPIRE 2023). Continuous marine mammal observational periods (BA-4 to BA-6, BA-11, BA-12, BA-31, Table 3.3-2) will be implemented, and therefore, reduce the risk of entanglement and interactions to marine mammals. The potential for entanglement of ESA-listed marine mammals in acoustic telemetry survey equipment is considered extremely unlikely to occur. A PAM plan, as discussed in Section 3.1.2.7, will be submitted to NMFS and BOEM for review and concurrence 180 days but no less than 120 days prior to start of activities. BOEM anticipates requiring that moored and autonomous PAM systems that may be used for monitoring would either be stationary (e.g., moored) or mobile (e.g., towed, autonomous surface vehicle [ASVs], or autonomous underwater vehicle [AUVs]), respectively. To minimize the risk of entanglement, mooring attached to the seafloor will use buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs that prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device (BA-37, Table 3.3-2). All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose. All buoys must be properly labeled with lessee and contact information. Further, to reduce the risk of entanglement from marine debris, BOEM-proposed measures (BA-36, Table 3.3-2) would require lost survey gear to be recovered when possible, and for all lost gear to be reported to BSEE. With the mitigation measures discussed above, the potential for entanglement of ESA-listed marine mammals in PAM survey equipment is considered extremely unlikely to occur and is discountable.

Given that survey activities anticipated are unlikely to pose an entanglement risk to ESA-listed marine mammals and that mitigation measures required for the survey activities would further reduce such risks, entanglement of ESA-listed marine mammals during fisheries surveys would be extremely unlikely to occur and are thus **discountable**. Therefore, the effects of fisheries and habitat surveys associated with the Proposed Action leading to injury due to capture or entanglement **may affect, not likely to adversely affect** ESA-listed marine mammals.

5.6.1.2 Sea Turtles

The capture and mortality of sea turtles in bottom trawl fisheries is well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992, 2008; NRC 1990; Murray 2006; Warden 2011; Murray 2015; Murray 2020). As discussed in recovery plans and 5-year status reviews for all sea turtle species, reduction of sea turtle interactions with fisheries is a priority where these species occur (NMFS and USFWS 1991, 1992, 2013, 2015a, 2015b, 2019, 2020; Conant et al. 2009; NMFS, USFWS and SEMARNAT et al. 2011). Finkbeiner et al. (2011) compiled sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, of which 4,500 were lethal, occurred annually since the implementation of bycatch mitigation measures. However, a vast majority (98 percent) of the interactions and mortalities (80 percent) occurred in the Southeast/Gulf of Mexico shrimp trawl fishery, although sampling inconsistencies and limitations should be considered when interpreting this data (NMFS 2016b).

While sea turtles are capable of remaining submerged for long periods of time, they appear to rapidly consume oxygen stores when entangled and forcibly submerged in fishing gear (Lutcavage and Lutz 1997). However, much of the available research (Epperly et al. 2002; Sasso and Epperly 2006) and anecdotal information from past trawl surveys indicates that limiting tow times to less than 30 minutes will likely eliminate the risk of death for incidentally captured sea turtles. Anticipated trawl surveys would be limited to tow times of 20 minutes (SMAST 2024). All tows would be completed during daylight hours, and trawling would be delayed if any protected species are sighted in the vicinity of the trawl tow. Additional mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear (BA-33, Table 3.3-2). Due to the low probability of interactions in the Project survey areas, and the negative impact of turtle exclusion devices (TEDs) on fish catch rates, TEDs will not be used on trawl surveys. All survey vessels, however, will have trained personnel (either dedicated protected species observers or trained crew members) conducting continuous monitoring of protected species during vessel operations and transits.

As with marine mammals, the proposed reduced bottom-time and the use of trained observers for trawl surveys would reduce the likelihood of capture for sea turtles. While no mortality is expected from the trawl survey, incidentally captured individuals would likely suffer stress and potential injury. Metabolic changes that impair a sea turtle's ability to function can occur within minutes of forced submergence, and in the event that forced submergence occurs, oxygen stores are rapidly consumed, anaerobic glycolysis is activated, and acid-base balance is disturbed, sometimes on lethal levels (Lutcavage and Lutz 1997). The proposed mitigation measures would be expected to minimize the risk of serious injury and mortality from forced submergence for sea turtles caught in the bottom trawl survey gear. Where possible, captured turtles would be disentangled and, if injured, may be brought back to rehabilitation facilities for treatment and recovery. This helps to reduce the rate of death from entanglement. Safe release, disentanglement protocols, and rehabilitation (Table 3.3.2, BA-35) would help to reduce the severity of impacts of these interactions. However, potential measurable effects on ESA-listed sea turtles due to trawl surveys may still occur and cannot be discounted.

The leatherback sea turtle may be particularly vulnerable to entanglement in trap/pot fishing gear, possibly due to its physical characteristics, diving and foraging behaviors, distributional overlap with the gear, and the potential attraction to prey items that collect on buoys and buoy lines at or near the surface (NMFS 2016b). Individuals entangled in pot gear generally have a reduced ability to forage, dive, surface, breathe, or perform other behaviors essential for survival (Balazs 1985). Gear entanglement can restrict blood flow to extremities and result in tissue necrosis and death from infection. Individuals that survive may lose limbs or limb function, decreasing their ability to avoid predators and vessel strikes (NMFS 2016b). The proposed ventless trap survey includes 30 stations that would be sampled twice monthly, and survey gear will be hauled after a three-day soak time. To reduce the risk of vertical line entanglement, ropeless fishing gear will be deployed during ventless trap surveys in lieu of traditional downlines and all groundlines will consist of sinking line (Table 3.3-2, BA-3). The primary method for retrieving trap strings will be grappling, though on-demand systems will continue to be tested and potentially phased into the survey as the technology progresses and becomes logistically feasible. In the event of incidental sea turtle capture, survey vessels would be required to carry adequate disentanglement equipment and crew trained in proper handling and disentanglement procedures. Thus, while there exists a possibility of sea turtle capture or entanglement in ventless trap surveys especially among leatherback sea turtles, the likelihood is considered very low with the proposed implementation of mitigation measures and limited duration of each survey event.

Neuston net sampling involves towing a plankton net at slow speeds (4 knots) for brief periods (10 minutes) in the upper 1.6 feet (0.5 meters) of the water column. As the neuston net frame measures 7.9 x 2 x 19.7 feet (2.4 x 0.6 x 6 meter) and features a mesh size of 0.5 inch (1,320 micrometers) and deployed off the stern of the vessel, this would not pose as an entanglement risk to sea turtles. Similarly, drop camera sampling occurs directly from the vessel's stern, with continuous seabed monitoring. HRG and benthic habitat monitoring surveys avoid gear that could entangle sea turtles. Thus, the risk of entanglement from neuston net, drop camera, and benthic habitat monitoring surveys is highly unlikely and can be discounted for ESA-listed sea turtles.

Acoustic telemetry to monitor the presence and movement of fish species would be conducted using fixed station acoustic receivers. As with marine mammals, continuous observational periods will be implemented to detect the presence of protected species in the area. Monitoring surveys are also expected to occur at short-term, regular intervals over the duration of the monitoring program. Therefore, the potential for entanglement of ESA-listed sea turtles in acoustic telemetry survey equipment is considered extremely unlikely to occur.

A PAM plan will be submitted to NMFS and BOEM for review prior to the start of activities. Monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement (Table 3.3-2). Therefore, passive acoustic equipment is not expected to pose a meaningful risk of entanglement to sea turtles. Surveys are also expected to occur at short-term, regular intervals over the duration of the monitoring program. Therefore, impacts of PAM survey equipment on ESA-listed sea turtles are expected to be negligible. Additionally, BOEM-proposed measures require sea turtle disentanglement protocols and equipment, sea turtle identification, data collection, and reporting of incidentally caught sea turtles during fishery surveys, and for vessel crews to be well-versed in sea turtle handling and resuscitation guidelines (Table 3.3-2, BA-12, BA-33, BA-34, BA-35). Further, to reduce the risk of entanglement from marine debris, BOEM-proposed measure BA-36 would require lost survey gear to be recovered when possible, and for all lost gear to be reported to BSEE.

Based on the potential survey methods identified, and with effective implementation of mitigation measures to minimize impacts from fisheries and habitat surveys, mortality of sea turtles is not anticipated. While the patchy distribution and low densities of sea turtles within 3 miles (5 kilometers) of the SouthCoast Lease Area (< 1 turtle per 100 square kilometers in and near the Lease Area for all species in any season) would reduce interactions with sea turtles in the Lease Area, the potential for incidental capture and entanglement cannot be discounted should an individual be encountered during trawl surveys. Therefore, the effects of fisheries and habitat surveys associated with the Proposed Action leading to injury due to capture or entanglement **may affect, likely to adversely affect** ESA-listed sea turtles.

5.6.1.3 Fish

Capture of Atlantic sturgeon in trawl gear has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Collins et al. 2000; Moser et al. 2000; Moser and Ross 1995). However, the use of trawl gear has been employed as a safe and reliable method to capture sturgeon, provided that the tow time is limited. A review of 8 long term trawl surveys recorded no injuries or mortalities among nearly 900 caught Atlantic and shortnose sturgeon when trawls were limited to tow times of thirty minutes or less (NMFS 2014).

Adverse impacts on sturgeon resulting from trawling capture are related to tow speed and duration (Moser et al. 2000). Northeast Fisheries Observer Program data from Miller and Shepherd (2011) indicate that mortality rates of Atlantic sturgeon caught in otter trawl gear is approximately 5 percent. Short tow durations and careful handling of individuals once on deck are likely to result in a very low risk of mortality to captured individuals (NMFS 2014, 2016b). The methods for the proposed trawl survey will employ a tow speed of 3.0 knots and a tow duration of 20 minutes (SMAST 2024), greatly reducing the likelihood of Atlantic sturgeon being caught during survey activities. A bycatch analysis estimated that up to 119 Atlantic sturgeons could be captured incidentally during NEFSC-affiliated research using bottom trawl gear (NMFS 2016b). Northeast Fisheries Observer Program (NEFOP) data calculates mortality rates of Atlantic sturgeon caught in otter trawl gear are approximately 5 percent (Stein et al. 2004; ASMFC TC 2007). In the Hudson River, a trawl survey that incidentally captures shortnose and Atlantic sturgeon has been ongoing since the late 1970s (NMFS 2016b). To date, no serious injuries or mortalities of any sturgeon have been recorded in those surveys. In contrast, individual Atlantic sturgeon have been incidentally captured and released with minor injuries during trawl-based monitoring surveys conducted for the South Fork Wind project (BOEM 2023). While the dispersed nature of Atlantic sturgeon, the limited number of trawl tows, and expected short tow duration of fisheries and habitat surveys are not expected to result in Atlantic sturgeon mortality, trawl surveys could still result in the capture of some Atlantic sturgeon along with potential minor injuries associated with the action.

Although stationary baited pots pose a potential risk to Atlantic sturgeon, fish traps and pots were not identified as potential sources for capture of Atlantic sturgeon in the Northeast Fisheries Observer Program data (Dunton et al. 2015), and it is unlikely that the species would become entangled in the lines or pots. The proposed ventless trap survey includes 30 stations that would be sampled twice monthly, and survey gear will be hauled after a three-day soak time. Ropeless gear would be deployed in lieu of traditional downlines to avoid the risk of vertical line entanglement. The primary method for retrieving trap strings will be grappling, though on-demand systems will continue to be tested and potentially phased into the survey as the technology progresses and becomes logistically feasible. Should an Atlantic sturgeon be captured, survey vessels would be required to carry adequate disentanglement equipment and crew trained in proper handling and disentanglement procedures (Table 3.3-2, BA-35). Given the limited, dispersed distribution of Atlantic sturgeon in the Action Area, the limited duration of each survey event, and the implementation of mitigation measures to reduce such risks, the likelihood of capture or entanglement from ventless trap surveys are considered extremely unlikely to occur.

Neuston net sampling involves towing a plankton net at slow speeds (4 knots) for brief periods (10 minutes) in the upper 1.6 feet (0.5 meters) of the water column. The neuston net frame measures 7.9 x 2 x 19.7 feet (2.4 x 0.6 x 6 meter) and features a mesh size of 0.5 inch (1,320 micrometers). While incidental capture is possible, given the limited tow length duration and surface location of sampling, entanglement of Atlantic sturgeon from neuston net sampling is considered unlikely to occur. Drop camera sampling occurs directly from the vessel’s stern with continuous seabed monitoring and HRG and benthic habitat monitoring surveys avoid gear that could entangle Atlantic sturgeon. Thus, the risk of entanglement from neuston net, drop camera, and benthic habitat monitoring surveys is highly unlikely and can be discounted for ESA-listed Atlantic sturgeon.

Acoustic telemetry to monitor the presence and movement of fish species would be conducted using fixed station acoustic receivers. As with marine mammals, continuous observational periods will be implemented to detect the presence of protected species in the area. Monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement (BA-37, Table 3.3-2). Monitoring surveys are also expected to occur at short-term, regular intervals over the duration of the monitoring program. Therefore, impacts of acoustic telemetry survey equipment on the ESA-listed Atlantic sturgeon are expected to be negligible. Additionally, BOEM-proposed measures require Atlantic sturgeon identification, data collection, and reporting of incidentally caught sturgeon during fishery surveys and for vessel crews to be well-versed in sturgeon handling and resuscitation guidelines (Table 3.3-2, BA-12, BA-34, BA-35). Further, BOEM proposed measure BA-36 would require lost survey gear to be recovered if possible, and all lost gear will be reported to BSEE.

Based on the potential survey methods identified, and with effective implementation of mitigation measures to minimize impacts from fisheries and habitat surveys, mortality of Atlantic sturgeon is not anticipated. However, minor injuries and/or capture of the Atlantic sturgeon in trawl surveys could not be discounted. Therefore, the effects of fisheries and habitat surveys associated with the Proposed Action leading to injury due to capture or entanglement **may affect, likely to adversely affect** the ESA-listed Atlantic sturgeon.

5.6.2 Effects on Prey and/or Habitat

5.6.2.1 Marine Mammals

After descending through the water column, the trawl gear used for the proposed trawl survey operates on or very near the bottom. Right whales feed on copepods and blue whales feed on krill exclusively, which are expected to pass through trawl gear used for the Project and no impacts are expected from turbidity created by the gear. Sperm whales feed on deep water species that do not occur in the area to be surveyed. Fin and sei whales consume prey species that have the potential to be removed by trawl gear. However, based on the biological opinion for research surveys conducted by the Northeast Fisheries Science Center, the total prey fish per year removed from these surveys, regardless of season and location in the Atlantic coast region, is considered to be negligible compared to the overall fish consumption of blue, humpback, and fin whales (NMFS 2016b). Thus, any effects on marine mammal prey availability from the proposed bottom trawl survey are expected to be so small that they cannot be meaningfully measured, evaluated, or detected, and are, therefore, **insignificant**.

The proposed trap surveys would not have any effects on the availability of prey for NARWs, blue whales, fin whales, sei whales as their prey species are small enough to pass through the trap gear and are unlikely to be captured or removed from the forage area. Sperm whales feed on deep water species that do not overlap with the study area where trap activities would occur. Thus, any effects on marine mammal prey availability from the proposed trap survey are expected to be so small that they cannot be meaningfully measured, evaluated, or detected, and are, therefore, **insignificant**.

Neuston net sampling may capture prey for NARW and blue whales as sampling would occur at the upper 1.6 feet (0.5 meters) of the water column. Blue whales, however, typically feed in deep waters that generally do not overlap with the study area where sampling would occur. As the proposed neuston sampling would have short tow times (10 minutes) and small net volume, no measurable effect on NARW prey availability is expected. Similarly, fin and sei whale prey are not expected to be captured in volumes that could affect overall prey availability during neuston net sampling. Therefore, any effects on marine mammal prey availability from the proposed neuston net sampling are expected to be so small that they cannot be meaningfully measured, evaluated, or detected, and are, therefore, **insignificant**.

Benthic habitat surveys would involve sediment grab sampling that could potentially impact fin and sei whales that forage benthic prey items. The only marine mammal prey resource that could potentially be captured during the benthic habitat surveys are sand lance. However, given the limited extent of the benthic grab surveys, any removal of fin and sei whale prey species would be non-measurable and negligible compared to the overall fish consumption of ESA-listed marine mammals. Impacts on NARW, sperm, and blue whale prey are not anticipated as a result of benthic grab sampling and any such effects to marine mammal prey availability are expected to be so small that they cannot be meaningfully measured, evaluated, or detected, and are, therefore, **insignificant**.

Based on the survey methods identified, any measurable effect on the availability of prey is not expected, therefore, effects of fisheries and habitat surveys associated with the Proposed Action leading to impacts on prey or habitat **may affect**, **not likely to adversely affect** ESA-listed marine mammals.

5.6.2.2 Sea Turtles

Sea turtle prey items such as crabs (e.g., horseshoe crabs), whelks, and fish can be removed from the marine environment in trap gear and 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 proposed trawl surveys would not affect the availability of prey for leatherback and green sea turtles in the Action Area. However, 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. All bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms would shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerhead sea turtles, which are known to eat a variety of live prey or scavenge dead organisms (Limpus et el. 2001, Tomas et al. 2001, Casale et al. 2008). Disturbance of soft-bottom habitat in the Action Area during biological monitoring could also potentially affect Kemp's ridley sea turtles which forage in this type of habitat. However, such disturbance would be temporary and would affect a relatively small area of available habitat in the Action Area. The trawl survey is expected to have a sampling intensity of 60 tows per season between the Lease Area and control area at a deployment rate of one tow every 17.8 square kilometers (SMAST 2024). While the trawl survey would result in unavoidable impacts to target organisms including sea turtle prey species, the extent of habitat disturbance and number of organisms affected would be small in comparison to the baseline level of impacts from commercial fisheries and would not measurably impact the viability of any species at the population level. Therefore, any effects on sea turtles from collection of potential sea turtle prey in the trawl and trap survey gear would be so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, **insignificant**.

Neuston net sampling involves towing a plankton net (7.9 x 2 x 19.7 feet [2.4 x 0.6 x 6 meter] and features a mesh size of 0.5 inch [1,320 micrometers]) at slow speeds (4 knots) for brief periods (10 minutes) in the upper 1.6 feet (0.5 meters) of the water column, which may capture prey items for leatherback sea turtles. However, given the short tow time and small net volume, no measurable effect on leatherback prey availability is expected. No effect on overall prey availability is expected for loggerhead, green, and Kemp's ridley sea turtles during neuston net sampling. Therefore, any effects on sea turtle prey availability from neuston net sampling, is considered to be so small that they cannot be meaningfully measured, detected, or evaluated, and are, thus, **insignificant**.

Benthic habitat surveys would involve sediment grab sampling that could potentially capture benthic prey items for juvenile and adult loggerhead and Kemp's ridley sea turtles. However, given the limited extent of the benthic grab surveys, any removal of sea turtle prey species would be non-measurable and negligible compared to the overall benthic prey resource. Thus, any effects to sea turtle prey availability from benthic habitat surveys are considered to be too small to be meaningfully measured, detected, or evaluated, and are, therefore, **insignificant**.

Based on the survey methods identified, any measurable effect on the availability of prey is not expected, therefore, effects of fisheries and habitat surveys associated with the Proposed Action leading to impacts on prey or habitat **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.6.2.3 Fish

Atlantic sturgeon prey items such as sand lance may be inadvertently captured as bycatch in trap gear and during trawl surveys. Other infaunal prey items are less likely to be retained by this survey method. Where practicable, non-target organisms collected in trap gear or during trawl surveys would be returned to the environment and these bycatch would still be available as prey for Atlantic sturgeon. Trawls have the potential to disturb benthic habitat. However, such disturbance would be temporary and would affect a relatively small area of available habitat in the Action Area. Given that the trawl survey is expected to have a sampling intensity of 60 tows per season between the Lease Area and control area at a deployment rate of one tow every 17.8 square kilometers (SMAST 2024) and a relatively small area affected, trawl surveys are unlikely to result in a measurable change in the availability of Atlantic sturgeon prey and forage resources. Any effects on Atlantic sturgeon prey availability from trawl and trap surveys would be too small to be meaningfully measured, detected, or evaluated, and are, therefore, **insignificant**.

Benthic habitat surveys would involve sediment grab sampling that could potentially capture benthic prey items for Atlantic sturgeon such as the sand lance. However, given the limited extent of the benthic grab surveys, any removal of prey species would be non-measurable and negligible compared to the overall benthic prey resource. Thus, any effects to Atlantic sturgeon prey availability from benthic habitat surveys are considered to be too small to be meaningfully measured, detected, or evaluated, and are, therefore, **insignificant**.

Atlantic sturgeon primarily feed on benthic prey and would not be affected by neuston net sampling, thus, this survey would have **no effect** on prey availability.

Based on the survey methods identified, any measurable effect on the availability of prey is not expected, therefore, the effects of fisheries and habitat surveys associated with the Proposed Action leading to impacts on prey or habitat **may affect, not likely to adversely affect** the ESA-listed Atlantic sturgeon.

5.7 Air Emissions

Air emissions would be generated during the construction, O&M, and decommissioning phases of the Proposed Action. Emissions would primarily be generated by Proposed Action vessels and the installation equipment on board Proposed Action vessels. The total construction phase air emissions and the total O&M phase air emissions for the Proposed Action are shown in Table 5.7-1, which is derived from SouthCoast Wind's air emissions inventory provided in Appendix G, *Air Emissions Report*, of the COP (SouthCoast Wind 2023).

The OCS air Regulations, presented in 40 CFR 55, establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement, for facilities subject to Section 328 of the Clean Air Act. Emissions from Project activities offshore would be permitted as part of an OCS air permit issued by the USEPA and must demonstrate compliance with National Ambient Air Quality Standards (NAAQS). SouthCoast Wind submitted an OCS Air Permit application to USEPA in November 2022 and a revised application in April 2023.

The installation of the SouthCoast Wind Project provides a clean energy alternative for the state(s) that will get power supplied from the Project. Emissions of CO_2, NO_x, and SO_2 associated with a similarly sized fossil-fuel fired generator in the Project area were estimated using emission factors from EPA's Avoided Emissions and Generation Tool (AVERT) version 3.0. These emissions would act as a hypothetical baseline to then subtract emissions associated with the SouthCoast Wind OCS Project construction and operations. In essence, the Commonwealth of Massachusetts avoids 692 tons of NO_x emissions per year or 22,825 tons over the Project lifespan, 4,038,482 tons of CO^2 emissions per year or 133,269,904 tons over the Project lifespan, and 313 tons of SO_2 emissions per year or 10,324 tons over the life of the Project by choosing an offshore wind project over a fossil-fueled fired project of equal power output.

Table 5.7-1. SouthCoast Wind Total Air Emissions (U.S. tons)

	Total Emissions (tons)												
	Total Fuel Use (gal)	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2	CH_4	N_2O	Pb	HAPs	CO_2e
Construction Phase Air Emissions[1]													
Year 1	11,037,093	2,352	104	497	469	244	91	159,360	0.73	5.5	$8.2e^{-3}$	5	160,834
Year 2	60,374,086	12,819	545	2,542	818	446	498	834,012	4.1	30	$4.7e^{-2}$	28	842,139
Year 3	84,982,427	18,728	733	3,872	1,016	560	730	1,214,881	6.2	46	0.07	40	1,227,336
Year 4	25,842,115	6,066	208	1,373	594	316	237	398,774	2.2	16	$2.6e^{-2}$	12	403,096
Total	182,235,721	39,965	1,590	8,284	2,897	1,566	1,556	2,607,027	13.2	98	0.15	85	2,633,405
Total O&M Phase Air Emissions													
Project Lifespan	110,110,702	24,061	441	5,922	787	614	933	1,548,541	10	71	0.11	51	1,613,637
Annual (tons per year)	3,336,688	729	13	180	24	19	28	46,925	0.3	2.2	$3.5e^{-3}$	1.6	48,898

CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide; HAPs = hazardous air pollutants; N_2O = nitrous oxide; NO_X = nitrogen oxides; Pb = lead; PM10 = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ particulate matter with an aerodynamic diameter less than or equal to 2.5 microns; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1]SouthCoast Wind has revised its construction schedule to 7 years from 4 years; however, SouthCoast Wind COP Appendix G (the source for the emissions data in this table) reflects 4 years of construction emissions. BOEM expects that total construction emissions over a 7-year period would be similar to the totals shown in the table, but that maximum annual emissions would be less than in the table because construction would be spread out over 7 years instead of 4.

Source: SouthCoast Wind Air Emissions Report (Appendix G, SouthCoast Wind 2023)

Construction and installation and O&M vessels are the primary source of Project-related emissions that could potentially affect ESA-listed marine mammals and sea turtles. ESA-listed fish species would not be exposed to airborne emissions and would therefore not be affected by this stressor. Most Project vessels are ocean-going ships and tugs powered by diesel engines with exhaust stacks that discharge emissions above the vessel. Summaries of estimated annual and total pollutant emissions during Project construction and installation and O&M are provided in Table 5.7-1. Project vessel activities during construction would result in short-term increases in Project-related air emissions. During O&M, Project vessels would result in long-term increases in emissions; however, estimated air emissions from O&M vessel activities would be lower than emissions generated during construction activities due to fewer vessels operating daily and are not expected to have a significant effect on regional air quality. Air emissions during decommissioning are expected to be similar to or lower than emissions estimated for construction activities.

5.7.1 Marine Mammals

Whales could be particularly vulnerable to concentrated pollutant emissions, as they do not have sinuses to filter air and lack olfactory receptors that would allow them to sense and perhaps avoid vessel emissions. Additionally, whales spend much of their time diving, which increases air pressure in their lungs allowing for pollutants to enter their blood more rapidly than for non-diving animals at normal atmospheric pressure (B.C. Cetacean Sightings Network 2022). While individual animals may periodically approach mobile Project vessels, it is unlikely that whales would remain close enough to those vessels for long enough periods of time to experience an adverse level of exposure to vessel emissions. The effects of air pollution on marine mammals are not well-studied, and air emissions are not an IPF of concern for marine mammal species (BOEM 2019a). Given that long-term effects of Project vessel activities on regional air quality are expected to be insignificant and that compliance with the NAAQS will ensure that air quality does not significantly deteriorate from baseline levels, the air emissions produced by Project vessels are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are **insignificant**. The effects of air emissions from Project vessels **may affect, not likely to adversely affect** ESA-listed marine mammals**.**

5.7.2 Sea Turtles

Sea turtle exposures to air pollutant emissions during Project construction and installation and O&M are anticipated to be temporary and short-term in duration. Given the fact that vessel exhausts are located high above the water surface, and most vessel activity will occur in the open ocean where exhaust will be readily dispersed by steady winds, the likelihood of individual animals being repeatedly exposed to high concentrations of airborne pollutants from Project vessels and equipment is low. Since construction and decommissioning activities will likely require similar equipment such as vessels for transportation, driving and removing piles and laying and removing cable, it is assumed that air quality impacts would be similar. Although sea turtles are capable of diving for long periods and have different diving patterns, these animals respire air with very little cutaneous exchange (Jackson 1985, Hays et al. 2000). Not many studies have been conducted to assess air quality impacts on sea turtles; however, the NAAQS are designed to ensure that air quality does not significantly deteriorate from baseline levels. Additionally, the Project's use of CTVs for crew transport have the potential to employ technology that reduces emissions compared to standard in-water hull and propeller vessels. It is reasonable to conclude that any effects on ESA-listed sea turtles from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are **insignificant**. Therefore, the effects of air emissions from the Project **may affect, not likely to adversely affect** ESA-listed turtles.

5.7.3 Fish

As stated previously, fish do not breathe air, thus air emissions from the Project will have **no effect** on ESA-listed Atlantic sturgeon.

5.8 Port Modifications

No port modifications are proposed as part of the Proposed Action.

5.9 Repair and Maintenance Activities

As described in Section 3.1.2, repair and maintenance activities during O&M of the Proposed Action would include inspections and any necessary repairs and replacements identified during inspections. Some inspections (e.g., surveys of submarine export cables) may generate noise which could affect ESA-listed species. Effects of these types of surveys on ESA-listed species were previously addressed in Section 5.2. Though not anticipated, repairs to faulty submarine cables may require additional cable laying activities that could result in noise and turbidity impacts on ESA-listed species in the Action Area. These impacts were previously assessed in Sections 5.2.3 and 5.5.3, respectively, and the effects on ESA-listed species was determined to be **insignificant**. Therefore, the effects of repair and maintenance activities from the Project **may affect, not likely to adversely affect** any of the ESA-listed species**.**

5.10 Other Effects

5.10.1 Potential Shifts or Displacement of Ocean Users (vessel traffic, recreational and commercial fishing activity)

The presence of offshore structures associated with the Proposed Action could displace commercial or recreational fishing vessels to areas outside of the Lease Area or potentially lead to a shift in gear types due to displacement and introduction of structured habitat in the Lease Area. If displacement leads to an overall shift from mobile to fixed gear types, there could be an increased number of vertical lines in the water, increasing the risk of interactions between ESA-listed species and fishing gear, which is described in Section 5.5.7.

Additional vessel traffic during construction may cause difficulties with navigation and increased risk of collision, therefore causing some fishing or other vessels to change normal routes. Once construction is completed, some commercial fisherman may avoid the Lease Area if large numbers of recreational fisherman cause vessel congestion. See Section 5.4.1 for further discussion of the risk of vessel strikes on marine mammals, sea turtles, and marine fish.

Due to the large distance of SouthCoast Wind's Lease Area from shore, the likelihood of a significant increase in recreational fishing vessel traffic in the Lease Area is low. This is particularly true when compared to the Block Island Wind Farm. Outreach by SouthCoast Wind to the local recreational fishing community has shown that the distance of 23 miles (37 kilometers) from the closest turbine to shore will preclude large increases in recreational fishing vessel traffic owing to the time/fuel considerations and the composition of the recreational fishing fleet. Outreach to the recreational fishing community as well as anecdotal observations by SouthCoast Wind G&G survey vessels indicate that a small number of larger recreational fishing vessels utilize the Lease Area during the summer months to target high profile gamefish, while a larger number of more diverse recreational fishing vessels utilize the export cable corridors and surrounding area to target a wider array of species.

5.10.1.1 Marine Mammals

Structures in the water could result in fishing vessel displacement or gear type shift. The potential impact on marine mammals from these changes is uncertain. However, if a shift from mobile gear to fixed gear occurs due to inability of fishermen to maneuver mobile gear, or due to increased vessel congestion from recreational fishing, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear (as described in Section 5.5.7). These potential long-term, intermittent impacts would be low in intensity and persist until decommissioning is complete and structures are removed.

The long-term presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns, potentially changing exposure to commercial and recreational fishing activity. The evidence for long-term displacement is unclear and varies by species and location. With only short-term displacement of harbor porpoises (1-2 days) during construction of a North Sea wind farm, it was shown that there were no population level impacts (Kraus et al. 2019; Brandt et al. 2016). Tielmann and Carstensen (2012) observed long-term (greater than 10 years) displacement of harbor porpoises from commercial wind farm areas in Denmark, while other marine mammals may be attracted to wind farm areas by increases in prey. If commercial fishing is displaced from the Lease Area and into adjacent areas, there is potential for reduction in prey in those areas removed by fishing pressure. Displacement effects remain a focus of ongoing study.

While the potential for displacement effects (i.e., gear shift, recreational fishing congestion, and changes in interactions with fishing lines) are acknowledged, the likelihood and significance of adverse effects on ESA-listed marine mammals is at present unknown but expected to be **insignificant**. Therefore, the potential displacement of ocean users during operations **may affect, not likely adversely affect** ESA-listed marine mammals.

5.10.1.2 Sea Turtles

One possible long-term impact of the presence of structures during O&M is the concentration of recreational fishing around foundations, potentially increasing the risk of sea turtle entanglement in both vertical and horizontal fishing lines and increasing the risk of injury and mortality (as described in Section 5.5.7). A majority of the recreational and commercial prime fishing areas and fishing activity occurs outside of the Project area (COP Appendix X; SouthCoast Wind 2023). If there is an increase in recreational fishing in the Project area, it is likely that this will represent a shift in fishing effort from areas outside the Lease Area to within the Lease Area and/or an increase in overall effort. Given vessel safety concerns regarding being too close to foundations and other vessels, the likelihood of recreational fishermen aggregating around the same turbine foundation at the same time is low. Due to foraging strategies, leatherback and loggerhead sea turtles are more likely to be exposed to recreational fishing lines in the pelagic Lease Area, while Kemp’s ridley and green sea turtles are less likely to be exposed.

Project construction activities could result in some level of displacement of sea turtles out of the Lease Area and into areas with higher levels of vessel traffic and/or recreational or commercial fishing activity. If structures result in vessel displacement or shifts in gear types, the potential effects on sea turtle populations are uncertain, but due to the patchy distribution and low densities of sea turtles in the Project area, is likely to be **discountable**. Therefore, the potential displacement of ocean users during operations **may affect, not likely to adversely affect** ESA-listed sea turtles.

5.10.1.3 Fish

One possible long-term impact of the presence of structures during O&M is the concentration of recreational fishing around foundations, potentially increasing the risk of Atlantic sturgeon entanglement in both vertical and horizontal fishing lines (as described in Section 5.5.7). A majority of the recreational and commercial prime fishing areas and fishing activity occurs outside of the Project area with medium to low levels of fishing in the northern portion of the Project area and sparse, low levels of fishing in the southern portion of the Project area (DNV-GL 2021). If there is an increase in recreational fishing within the Project area, it is likely that this will represent a shift in fishing effort from areas outside the Lease Area to within the Lease Area and/or an increase in overall effort. The presence of structures could also result in fishing vessel displacement or gear type shift. The potential impact on Atlantic sturgeon from these changes is uncertain. Given vessel safety concerns regarding being too close to foundations and other vessels, the likelihood of recreational fishermen aggregating around the same turbine foundation at the same time is low.

Due to their benthic foraging strategy, Atlantic sturgeon have a reduced chance of being exposed to recreational fishing lines in the pelagic Lease Area. Further, due to the large distance of SouthCoast Wind's Lease Area from shore, the likelihood of a significant increase in recreational fishing vessel traffic in the Lease Area is low. While the potential for displacement effects is acknowledged, the likelihood and significance of adverse effects on Atlantic sturgeon is at present unknown but expected to be **insignificant**. Therefore, the potential displacement of ocean users during operations **may affect, not likely to adversely affect** ESA-listed Atlantic sturgeon.

5.10.2 Unexpected/Unanticipated Events

Unexpected or unanticipated events with the potential to affect ESA-listed species could occur during the construction, O&M, or decommissioning phases of the Proposed Action. Such events would include vessel collisions or allisions (i.e., collisions with stationary structures) (Section 5.10.2.1), severe weather events resulting in equipment failure (Section 5.10.2.2), or oil spills/chemical releases (Section 5.10.2.3).

5.10.2.1 Vessel Collision/Allision with Foundation

Vessel collisions or allisions may result in accidental discharges of fuel, fluid, or hazardous materials, which are addressed in Section 5.4.2. These events are considered unlikely given the lighting requirements for Project vessels and offshore structures, vessel speed restrictions, proposed spacing of Project structures, inclusion of Project structures on navigational charts, and Notices to Mariners issued by the U.S. Coast Guard. Therefore, effects on ESA-listed species due to vessel collisions or allisions are extremely unlikely to occur and are **discountable**. Given the low likelihood of effects, the effects of vessel discharges associated with collisions or allisions **may affect, not likely adversely affect** any of the ESA-listed species considered.

5.10.2.2 Failure of WTGs due to Weather Events

The Lease Area may be affected by hurricanes or extratropical storms, which are common in the area between October and April. The high winds associated with these events have the potential to result in the failure of WTGs. However, such a failure is highly unlikely, as these structures are designed to withstand significant storms, and effects on ESA-listed species associated with WTG failure are extremely unlikely to occur and are **discountable**. Given the low likelihood of occurrence, the effects of catastrophic WTG failure leading to injury or mortality **may affect, not likely to adversely affect** any of the ESA-listed species considered.

5.10.2.3 Oil Spill/Chemical Release

Vessel traffic associated with the Proposed Action would increase the risk of accidental releases of fuels, fluids, and hazardous materials. Potential effects from the accidental release of chemical contaminants from Project vessels on ESA-listed species are discussed in Section 5.4.2. Similar effects would be expected from the accidental release of fuels, fluids, and hazardous materials from WTGs or OSPs on

ESA-listed species. The risk of any type of accidental release from WTG or OSPs would be increased, primarily during construction, but also during O&M and decommissioning of offshore wind facilities. The total volume of WTG and OSP fuels, fluids, and hazardous materials associated with the Proposed Action is outlined in Table 3.1-2. Fuel oil, lubricants, coolants, and dielectric fluids have the potential to be accidentally released during material transfers, or if a catastrophic event causing structural damage to the WTGs or OSPs sufficient to breach structural containment were to occur. Only a complete and catastrophic collision with a large oil tanker or freighter could lead to an oil spill associated with the total loss of the OSP. Collision between smaller vessels (e.g., maintenance vessel, recreational, or commercial fishing vessel) and a WTG or OSP foundation will not cause a release of oil from a WTG or OSP but may cause a release of oil from the colliding vessel. The one by one nautical mile grid spacing of WTG and OSP positions makes impact to more than one foundation highly unlikely. Further, the use of 1 nautical mile spacing across all of the Massachusetts/Rhode Island lease areas further minimizes the potential for collision.

An estimate of the release predictions based on each major type of container failure that could potentially occur is outlined in Table 8-3, Section 8.3.1 of the SouthCoast Wind Oil Spill Response Plan (OSRP) (Appendix AA, SouthCoast Wind 2023). Each release prediction includes the quantity of oil released, rate of release, containment measure in place, and response actions. The total quantity of oil estimated in the release is based on a worst-case discharge using the maximum container volume. The maximum predicted discharge due to a failure, rupture, or leak of components are the following: 150,000 gallons of dielectric insulating oil from an OSP transformer, 7,000 gallons of diesel fuel from an OSP backup generator diesel fuel tank, 2,000 gallons of silicon-based dielectric fluid from a WTG transformer, and 800 gallons of lubricating oil and/or coolant from a WTG gearbox. As part of the secondary containment measures, transformers are equipped with an integral oil pan capable of containing 115 percent of the dielectric volume. As such, and absent catastrophic damage to the WTG structure, release of fluids from the WTG transformers to adjacent waters is unlikely. The WTGs are designed to be self-containing such that any leaks would be directed to collection areas within the turbine structure and in most cases, will not result in a discharge to the adjacent waters. The 4,500-gallon emergency diesel generator tank is a double-walled tank positioned within a secondary containment structure capable of containing 115 percent of the diesel generator tank volume on the OSP. Therefore, this tank is provided with tertiary containment further reducing the possibility of a release occurring from this tank system. In addition, the OSP itself provides additional containment. BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Thus, the occurrence of this type of catastrophic release due to the structural damage of a WTG or OSP foundation, is extremely small.

As noted in Section 5.4.2.1, SouthCoast Wind has developed an OSRP (Appendix AA, SouthCoast Wind 2023) with measures to avoid accidental releases and a protocol to respond to such a release if one occurs. SouthCoast Wind will comply with regulatory requirements related to the prevention and control of discharges and accidental spills as documented in the proposed Project’s OSRP. Therefore, effects on ESA-listed species due to oil spill/chemical release are extremely unlikely to occur and are **discountable**. Given the low likelihood of occurrence and low relatively low volumes involved, effects of oil spills or chemical releases from vessels or Project structures **may affect, not likely to adversely affect** any of the ESA-listed species considered.

6. Other Relevant Action Alternatives

BOEM considered four relevant action alternatives to the Proposed Action (Alternatives C through F in the EIS). The impact analyses, effects determinations, and conclusions for Alternatives C through F would not be materially different from those of the Proposed Action.

Under Alternative C (Fisheries Habitat Impact Minimization), BOEM developed onshore cable route options that would avoid placing the offshore export cable in the Sakonnet River. Under this alternative, the construction, O&M, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the SouthCoast Wind COP, subject to applicable mitigation measures. BOEM worked with SouthCoast Wind to identify feasible onshore cable routes to avoid the Sakonnet River and identified two onshore route alternatives: Aquidneck Island, Rhode Island Route and Little Compton/Tiverton, Rhode Island. The ESA-listed species that would potentially benefit from this are the sea turtles and Atlantic sturgeon. However, these species, in particular sea turtles, are uncommon in the river, and cable laying activities would still occur at all other project locations.

Alternative D (Nantucket Shoals) intends to address potential impacts on foraging habitat and potential displacement of protected species in the northeastern portion of the Lease Area by eliminating up to six WTG foundations. The six WTG positions that would not be developed are located on the northeastern edge of the Lease Area, which is near Nantucket Shoals (Figure 6-1). This area exhibits higher modeled relative abundance of gammarid amphipods and chlorophyll in the spring, which is correlated with increased NARW abundance in that area in the spring and winter. Potential impacts on ESA-listed species from noise, cable emplacement and maintenance, presence of structures, habitat alteration and EMF could be reduced by the removal of up to six WTGs in the northeastern portion of the Lease Area. Overall, Alternative D is expected to lessen the duration for the IPFs in comparison to those described for the Proposed Action.

Under Alternative E (Foundation Structures), the construction and installation, O&M, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters, which includes a range of foundation types, subject to applicable mitigation measures. This alternative includes three foundation options, which assume the maximum use of piled (monopile and piled jacket), suction bucket, and GBS foundations to assess the extent of potential impacts from each foundation type: Alternative E-1: Piled Foundations (monopile and piled jacket) only; Alternative E-2: Suction Bucket Foundations only; Alternative E-3: GBS Foundations only.

Alternative F (Muskeget Channel Cable Modification) was developed to minimize impacts on complex habitats and reduce seabed disturbance in the Muskeget Channel east of Martha's Vineyard in response to concerns from NMFS. Under Alternative F, the construction, O&M, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the SouthCoast Wind COP, subject to applicable mitigation measures. However, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ±525 kilovolts HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. The OSP design for the offshore export cables connecting to Brayton Point would remain unchanged from the Proposed Action. As a result, there would be two HVDC converter OSPs under Alternative F – one HVDC converter OSP for Brayton Point and one HVDC converter OSP for Falmouth. In addition, Alternative F would install up to three offshore export cables to Falmouth, instead of up to five offshore export cables under the Proposed Action.

The impact of each IPF with consideration to each Proposed Action alternative is discussed below:

Noise: The roughly 4 percent reduction in the number of WTGs for Alternative D would reduce the overall number of impact pile-driving hours required for installation from 588–882 hours to 564–846 hours. Overall, the number of pile-driving hours under Alternative D would be reduced by 24–36 hours in comparison to the Proposed Action. The specific effects are likely to remain the same for marine mammals including masking, disturbance, and PTS. However, by limiting the duration of the effect, the number of marine mammals exposed to underwater sound in excess of acoustic thresholds could be reduced. This could be important for species who are sensitive to impact pile-driving activities including baleen whales, which are low-frequency specialists with known sensitivity to the low frequencies of pile-driving noise. A reduction of WTGs under Alternative D would also result in a reduction in the number of construction vessels or the duration of vessels in the Project area during construction activities that would be required for installation. The magnitude of the effects of underwater noise from Project vessels during construction would remain the same, but the duration of the effects would be reduced. Although certain impacts may be minimally decreased in duration and geographic extent, the differences between Alternative D and the Proposed Action do not have the potential to significantly reduce or increase impacts on ESA-listed species.

Alternative E includes the use of all piled (Alternative E-1), all suction bucket (Alternative E-2), or all GBS (Alternative E-3) foundations for WTGs and OSPs. Installation activities would not differ between the Proposed Action and Alternative E-1, which assumes pile driving would be used for all foundations with corresponding noise impacts. Under Alternatives E-2 and E-3, no pile driving would occur; therefore, there would be no underwater noise impacts on ESA-listed species due to pile driving. The avoidance of pile-driving noise impacts would reduce overall construction and installation impacts under Alternatives E-2 and E-3 compared to the Proposed Action. Construction, O&M, and decommissioning would still, however, result in impacts to ESA-listed marine mammals, sea turtles, and fish. Impacts are magnified in severity for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual. Overall, impacts of Alternative E would be similar to impacts of the Proposed Action with the most notable difference in the reduction of short-term impacts from avoidance of pile-driving noise and the increase in long-term impacts from larger foundation footprints.

EMF: Under Alternative D, a reduction in WTGs would result in a reduction of interarray cable, which would limit the footprint of potential EMF exposure, especially for ESA-listed species that forage on benthic prey species near the cable. A roughly 4 percent reduction in WTGs under Alternative D would result in 19.9 miles (32 kilometers) less interarray cable length within the Project area. Given that Alternative D only represents a reduction of up to six WTGs, impact levels would be the same as the Proposed Action.

Though fewer DC cables would be installed under Alternative F within the Falmouth ECC (three DC cables under Alternative F compared to five AC cables under the Proposed Action), the amplitude of EMF generated by DC cables can be up to three times greater than that of AC cables (Hutchison et al. 2020). However, AC and DC EMFs differ in the way they interact with organisms and direct comparisons cannot be made (CSA Ocean Sciences, Inc. and Exponent 2019). Measures to reduce EMF into the surrounding area, including cable burial and shielding where sufficient burial is not possible, are expected to reduce the EMF of DC cables to levels where impacts from EMF are localized to the immediate area of the cable (CSA Ocean Sciences, Inc. and Exponent 2019). Previous studies on DC undersea cables have shown only temporary alterations in mobility and behavior of some fish species with no appreciable effects on overall movement or population health (Klimley et al. 2017; Wyman et al. 2018). Because impacts associated with cable installation and maintenance would still occur in the same corridor, the impacts on EMF-sensitive species under Alternative F would be slightly reduced but not materially different than those described for the Proposed Action.

Presence of structures: Under Alternative D, a reduction in WTGs potential impacts on marine mammals due to the presence of structures could be realized with the removal of up to six WTGs in the northern portion of the Lease Area. Northern portions of the Lease Area are frequented by NARWs (Figure 6-1), and a reduction in offshore wind development in this area may lessen the impacts on these species.

Nantucket Shoals is relatively shallow (< 164 feet [50 meters]) and an area of high biological productivity (Townsend et al. 2006). This broad area extends south, southeast and east of Nantucket and contains complex, dunelike topography which reflects the strong tidal currents (PCCS 2005). The shoals are known to be consistently colder than surrounding waters proven by satellite images of sea surface temperature and are tidally well mixed (Townsend et al. 2006). A trend of higher near surface chlorophyll is greater inshore than offshore (Townsend et al. 2006). The year-round productivity of Nantucket Shoals is known to attract primarily NARWs and fin whales, which may use the area for congregation, feeding, or passing through (PCCS 2005). The removal of six WTGs in this area may lessen the impacts on marine mammals by providing more area of open ocean nearest to Nantucket Shoals foraging habitat.

Additionally, the reduction of 6 WTGs near Nantucket Shoals, under this alternative, may lessen the impacts to marine mammals by providing more area of open ocean for foraging as well as allow some benefits to ESA-listed species by minimizing disturbance to important prey habitats. The removal of WTGs could, however, reduce reef and hydrodynamic effects, which may then reduce foraging opportunities for some ESA-listed species compared to the Proposed Action. The presence of vertical structures in the water column may influence primary and secondary productivity and the distribution and abundance of invertebrate and fish community structures within and in proximity to Project footprints; however, modeling of the full build-out of the entire southern New England lease areas indicate that only localized changes to the physical hydrodynamic features may occur on the western side of Nantucket Shoals adjacent to the Massachusetts and Rhode Island offshore wind lease areas (Johnson et al. 2021). There is a lack of conclusive evidence that removal of turbines in the northern portion of the SouthCoast Wind Lease Area would measurably lessen the impacts on the hydrodynamic features associated with Nantucket Shoals. While BOEM expects small reductions in the presence of structures under Alternative D, impacts from the remaining 143 WTG/OSPs would still occur and would not change the overall impact magnitude of the Project and Proposed Action.

Alternative C would avoid EFH and Habitat Area of Particular Concern (HAPC) by avoiding cable installation in the Sakonnet River through an onshore alternative route. Alternative C-1 would reduce the total offshore export cable route by 9 miles (14 kilometers) and Alternative C-2 would reduce the total offshore export cable route by 12 miles (19 kilometers). These reductions in offshore export cable length would eliminate the construction and installation impacts from cable emplacement and anchoring in the Sakonnet River compared to the Proposed Action. The Sakonnet River contains a mix of soft bottom and complex substrates, which can be important benthic habitats for fish and invertebrates. In a few locations, live *Crepidula* sp. reefs or *Crepidula* sp. shell hash were found on the sediment surface overlying reduced silt (COP Appendix M.2; SouthCoast Wind 2023), which is a biogenic habitat that also adds complexity to the seafloor. This complex habitat, along with some boulder fields in Mount Hope Bay, are EFH for many species, and Alternative C will avoid the disturbance of this benthic habitat. Because the Sakonnet River is HAPC for juvenile Atlantic cod, there is a greater potential for Alternative C to avoid or minimize impacts on this species than the Proposed Action. As under the Proposed Action, SouthCoast Wind would use HDD for the installation of the Alternative C offshore export cables beneath the shallower nearshore areas at all landfall locations. This is expected to substantially reduce impacts of sediment dispersion on sensitive habitats, such as SAV and wetlands, which could serve as EFH. BOEM anticipates that potential effects from avoiding the installation of export cables in the Sakonnet River would result in a reduced, but not measurably different, impact on ESA-listed species.

While sightings of sea turtles in the Project area are uncommon, Kemp's ridley sea turtle is associated with coastal habitats and is known to forage in bays and estuaries across Rhode Island in the summer months (Schwartz 2021). This particular species of sea turtle would then be expected to benefit the most from the prevention of construction in the Sakonnet River. However, no measurable difference in the impacts on sea turtles are expected between the Proposed Action and Alternative C. Therefore, BOEM anticipates that impacts under Alternative C would not be measurably different from those anticipated under the Proposed Action.

Under Alternative E, the use of GBS foundations (E-3), would result in the greatest area of habitat conversion due to foundation footprint and scour protection. Alternative E-1 (piled foundations only) would result in at least a 77 percent reduction in footprint and scour protection, and Alternative E-2 (suction bucket foundations only) would result in at least a 58 percent reduction in footprint and scour protection, compared to Alternative E-3. Alternative E-2 and Alternative E-3 may have a greater artificial reef effect with increased surface area, which would benefit sea turtles, increase overall abundance and diversity of fish, and increase foraging opportunities for ESA-listed species. However, adverse impacts from these larger underwater structures may include entanglement in lost or discarded fishing gear, potential of vessel strike from increased recreational fishing vessel traffic, and incidental hooking. For example, the GBS of Alternative E-3 may have less entanglement potential as it has a smooth, sloping exterior in the water column compared to the suction bucket foundation of Alternative E-2 that has steel cross beams which may create more entanglement potential of marine debris and recreational fishing gear. Given that Alternative E includes increases in both beneficial and adverse impacts, there is not expected to be a measurable difference in impacts on ESA-listed species from those anticipated under the Proposed Action. BOEM anticipates that the impacts on ESA-listed species under Alternatives E-1, E-2, and E-3 would not be materially different from those anticipated under the Proposed Action.

Under Alternative F, the Falmouth offshore export cable route would use ±525 kilovolts HVDC cables connected to one HVDC converter OSP, instead of HVAC cables connected to one or more HVAC OSPs. During operation, there would be increased intake and discharge from the additional HVDC converter OSP, which could result in increased entrainment of prey of ESA-listed species compared to if only one HVDC converter OSP is used. The additional HVDC converter OSP associated with Falmouth would be located in deeper waters in the southern portion of the Lease Area at a further distance from Nantucket Shoals and potential impacts would remain localized in the immediate vicinity of the OSPs. Because SouthCoast Wind's preference under the Proposed Action is to use two HVDC converter OSPs in the Lease Area, as described in Section 3.1.2.2, which is also proposed under Alternative F, there would be no difference in impacts between the two alternatives. The Falmouth offshore export cable would include only three cables under Alternative F compared to five cables under the Proposed Action, which would reduce the total seafloor disturbance by approximately 700 acres. Overall, due to both adverse and beneficial impacts associated with Alternative F and given that the overall magnitude would be the same as in the Proposed Action, effects determination would likely not change.

Cable emplacement and maintenance: Alternative C would reduce cable-related impacts on fish within the Sakonnet River compared to the Proposed Action. The Sakonnet River is an important area for juvenile Atlantic cod and other species with EFH present, but overall impacts on this area under the Proposed Action area are anticipated to be small and make up a small portion of the overall Project impacts. The export cable reroute under Alternatives C-1 and Alternative C-2 would not cross other habitats important to ESA-Listed species, but it would have a reduced total length of offshore export cable installation, and is therefore, expected to have minimal impacts on ESA-listed species. Therefore, BOEM anticipates that impacts on ESA-listed species under Alternative C would not be measurably different from those anticipated under the Proposed Action.

Under Alternative D, a reduction in WTGs would result in less interarray cable within the Project area footprint and a reduction in area over which the emplacement disturbance and resulting impacts could occur. This would additionally limit short-term elevated turbidity in the Project area, reducing the number of ESA-listed species exposed to potentially adverse effects. Although certain impacts may be minimally decreased in duration and geographic extent, the differences between Alternative D and the Proposed Action do not have the potential to significantly reduce or increase impacts on ESA-listed species from the analyzed IPF. BOEM does not anticipate impacts to be measurably different from those described under the Proposed Action; thus, the effects determination would remain the same.

Under Alternative F, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use up to three ±525 kilovolts HVDC cables instead of up to five HVAC cables as proposed under the Proposed Action. Approximately 2,140 acres of complex habitat (coarse sediment, glacial moraine A, and boulder fields) can be found within an 8.2-mile (13.2-kilometer) segment of the Falmouth ECC as it crosses the Muskeget Channel (INSPIRE 2022). The total width of disturbance of the cables would be reduced from 98.5 feet (30 meter) (assuming a 19.7-foot-wide [6 meter] disturbance per cable; COP Volume 1, Table 3-29; SouthCoast Wind 2023) under the Proposed Action to 59.1 feet (18 meters) under Alternative F, reducing the extent of impacts on habitats along this segment of the Falmouth cable corridor from 98 acres to 59 acres. Depending on the final cable placement within the ECC, up to a 40-percent reduction in seabed disturbance from installation of the Falmouth offshore export cables can be anticipated which would reduce impacts on benthic habitats, in particular complex habitats found in the Muskeget Channel that may be important EFH. Additionally, lesser installation activity from fewer cable emplacements along the cable corridor may reduce the temporary construction impacts on ESA-listed species. Offshore impacts on marine mammal prey from cable emplacement and anchoring may also be reduced due to the lesser number of cables installed. Because impacts associated with cable installation and maintenance would still occur in the same corridor and there would be no change in impacts from other offshore components (e.g., WTGs), BOEM does not anticipate that impacts to ESA-listed species under Alternative F would be materially different than those described under the Proposed Action.

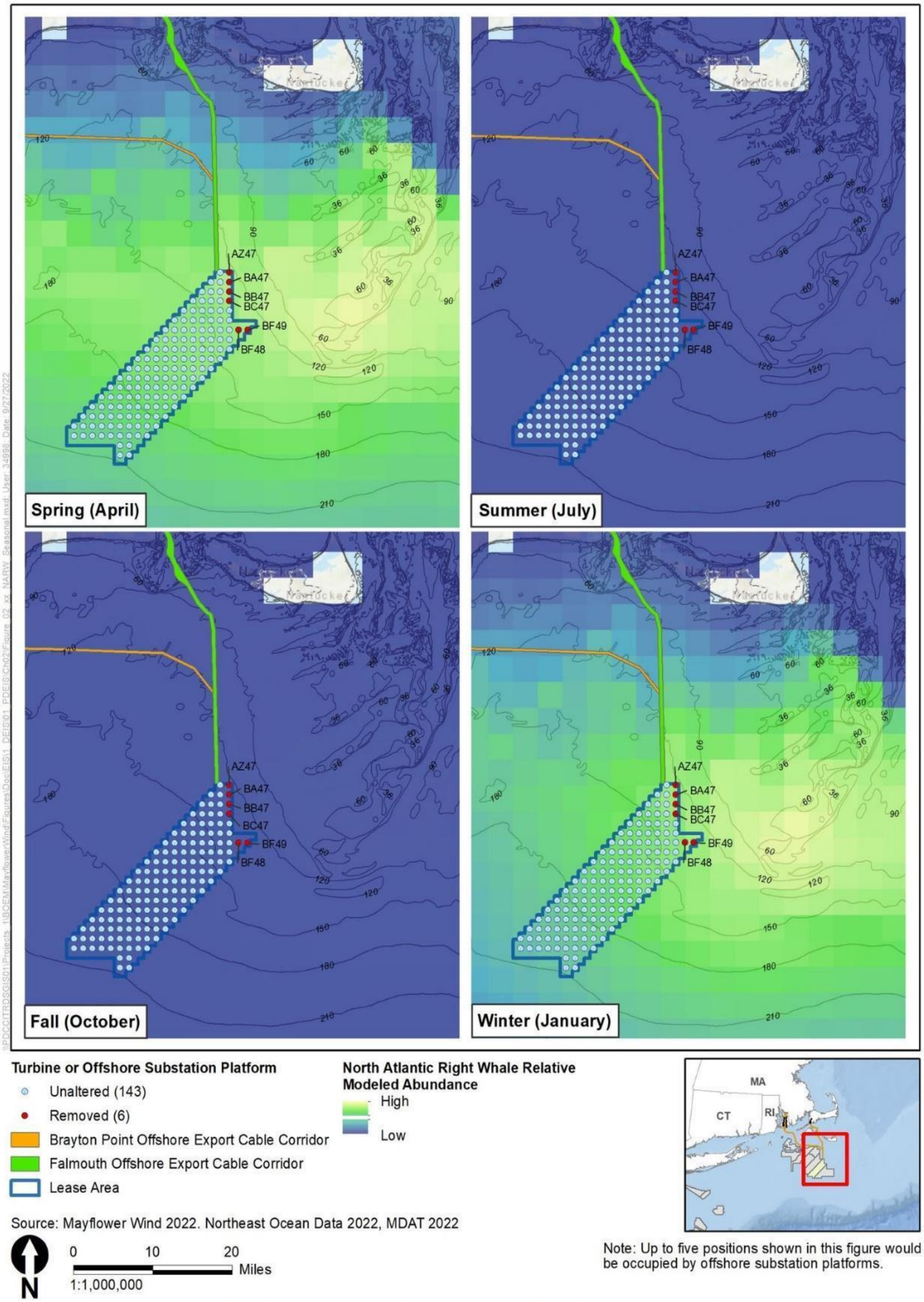

Figure 5.10-1. Alternative D WTG Removal and NARW seasonal density

7. Cumulative Effects[11]

Cumulative effects are defined as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area (50 CFR 402.02). Those activities involving Federal activities are excluded from consideration as they would require separate consultation under Section 7 of the ESA. The majority of activities which may occur within the Action Area for the Proposed Action would involve Federal activities, thereby requiring future consultation under the ESA. Potential future activities without Federal involvement that could occur in the Action Area include recreational fishing, state-regulated fisheries, marine transportation, recreational boat traffic, discharge of wastewater, and state or locally authorized coastal development. Effects of such activities are not expected to differ from the current environmental baseline (Section 4).

[11] "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]

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8. Conclusion

8.1 Summary of Effects Determinations

Table 8.2-1 summarizes the effects determinations for the listed marine mammals, sea turtles, and marine fish considered in this BA. Effects determinations incorporated the monitoring and mitigation measures outlined in Table 3.3-1 and Table 3.3-2.

8.2 Climate Change Considerations

As described in Section 4.10, climate change could affect ESA-listed species in the Action Area. Warming water temperatures associated with climate change could affect distribution of ESA-listed species or their prey, for species whose distribution is largely governed by water temperatures. Water temperature is generally not the most significant determinant of habitat usage for marine mammals. However, prey species distribution for some marine mammal species are affected by water temperatures. Recent changes in NARW distribution may be attributed to changes in the distribution of copepod prey in response to changing climate (Record et al. 2019). Warming may negatively impact the abundance of *Calanus* copepods, primary prey for NARW, on the Northeast U.S. shelf in the coming decades (Grieve et al. 2017), which could potentially reduce NARW foraging in the Action Area. Climate change is not expected to affect NARW use of the Action Area for other critical functions and is not expected to reduce the overall effects on NARWs associated with the Proposed Action. Climate change is not expected to have a measurable effect on usage of the Action Area by other ESA-listed marine mammal species and is therefore not expected to change the effects of the Proposed Action on these species.

Seasonal usage of the Action Area by ESA-listed sea turtle species is largely governed by water temperatures. Warmer water temperatures could increase the period of time in which sea turtles are likely to occur in the Action Area. However, any increase in the likely period of habitat use is expected to be small. Therefore, climate change is not expected to change the effects of the Proposed Action on ESA-listed sea turtle species.

Atlantic sturgeon exhibit seasonal migrations that are influenced by water temperatures, among other environmental and biological cues. Based on the large geographic distribution for Atlantic sturgeon, anticipated changes in water temperatures over the life of the Proposed Action are not expected to result in changes in use of the Action Area by Atlantic sturgeon. Habitat use by other ESA-listed fish species in the Action Area is largely governed by factors other than temperature. Therefore, climate change is not expected to change the effects of the Proposed Action on ESA-listed fish species.

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Table 8.2-1. Summary of Effects of Proposed Action on ESA-Listed Species[1] in the Action Area

IPF or Stressor	Marine Mammals					Sea Turtles				Fish
	Blue Whale	Fin Whale	[2]NARW	Sei Whale	Sperm Whale	Green	Kemp's Ridley	Leatherback	[2]Loggerhead	[2]Atlantic Sturgeon
Noise – Impact & Vibratory Pile-Driving – Injury **(PTS)**	No effect	NLAA Discountable	NLAA Discountable	NLAA Discountable	No effect	NLAA Discountable	NLAA Discountable	**LAA**	**LAA**	NLAA Discountable
Noise – Impact & Vibratory Pile-Driving – Behavioral Disturbance **(BD)**	NLAA Discountable	**LAA**	**LAA**	**LAA**	**LAA**	NLAA Discountable	NLAA Discountable	**LAA**	**LAA**	NLAA Discountable
Noise – G&G Surveys	**PTS:** No effect **BD:** NLAA Insignificant					**PTS:** NLAA Insignificant **BD:** NLAA Discountable				**PTS:** NLAA Discountable **BD:** NLAA Insignificant
Noise – Cable Laying	**PTS:** No effect **BD:** NLAA Insignificant					**PTS:** No effect **BD:** NLAA Insignificant				**PTS:** NLAA Discountable **BD:** NLAA Insignificant
Noise – Dredging	**PTS:** No effect **BD:** NLAA Insignificant					**PTS:** No effect **BD:** NLAA Insignificant				**PTS:** NLAA Discountable **BD:** NLAA Insignificant
Noise – UXO Detonation	**PTS:** NLAA Discountable **BD:** NLAA Insignificant					**PTS:** NLAA Discountable **BD:** NLAA Insignificant				**PTS:** NLAA Discountable **BD:** NLAA Discountable
Noise – Vessels	**PTS:** No effect **BD:** NLAA Insignificant					**PTS:** No effect **BD:** NLAA Insignificant				**PTS:** NLAA Discountable **BD:** NLAA Discountable
Noise – Helicopter & Drones	**PTS:** NLAA Discountable **BD:** NLAA Discountable					**PTS:** NLAA Discountable **BD:** NLAA Discountable				**PTS:** NLAA Discountable **BD:** NLAA Discountable
Noise – WTGs	**PTS:** NLAA Discountable **BD:** NLAA Insignificant					**PTS:** NLAA Discountable **BD:** NLAA Insignificant				**PTS:** NLAA Discountable **BD:** NLAA Insignificant
Risk of Vessel Strike	NLAA Insignificant					**LAA**				NLAA Insignificant
Vessel Discharges	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
G&G Surveys	No effect					NLAA Insignificant				NLAA Insignificant

IPF or Stressor	Marine Mammals					Sea Turtles				Fish
	Blue Whale	Fin Whale	[2]NARW	Sei Whale	Sperm Whale	Green	Kemp's Ridley	Leatherback	[2]Loggerhead	[2]Atlantic Sturgeon
Fisheries Surveys – Risk of Capture and Entanglement	NLAA Discountable					**LAA**				**LAA**
Fisheries Surveys – Effects on Prey and/or Habitat	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Habitat Conversion and Loss – Foundations and Scour Protection	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Habitat Conversion and Loss – Cable Emplacement	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Habitat Conversion and Loss – Spuds and Anchors	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Turbidity	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Dredging – Direct Effects	No effect					NLAA Discountable				NLAA Discountable
Dredging – Impacts on Prey	No effect					No effect	NLAA Insignificant	No effect	No effect	NLAA Insignificant
Trenching	No effect					No effect				No effect
Presence of WTGs on Atmospheric / Oceanographic Conditions	No effect	NLAA Insignificant	NLAA Insignificant	NLAA Insignificant	No effect	NLAA Insignificant				NLAA Insignificant
Physical Presence of WTGs on Listed Species	NLAA Discountable					NLAA Insignificant				NLAA Insignificant

IPF or Stressor	Marine Mammals					Sea Turtles				Fish
	Blue Whale	Fin Whale	[2]NARW	Sei Whale	Sperm Whale	Green	Kemp's Ridley	Leatherback	[2]Loggerhead	[2]Atlantic Sturgeon
EMF and Heat from Cables	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Lighting and Marking of Structures	NLAA Insignificant					NLAA Insignificant				NLAA Discountable
Offshore Substations – Water Withdrawal and Discharge	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Offshore Substations – Impacts on Prey	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Air Emissions	NLAA Insignificant					NLAA Insignificant				No effect
Port Modifications[2]	Not Applicable									
Repair and Maintenance Activities	NLAA Insignificant					NLAA Insignificant				NLAA Insignificant
Potential Shifts of Ocean Users	NLAA Insignificant					NLAA Discountable				NLAA Insignificant
Vessel Collision/Allision with Foundation	NLAA Discountable					NLAA Discountable				NLAA Discountable
Failure due to Weather Events	NLAA Discountable					NLAA Discountable				NLAA Discountable
Oil / Chemical Spill	NLAA Discountable					NLAA Discountable				NLAA Discountable

[1] Rice's whale, Hawksbill turtle, Atlantic salmon, giant manta ray, Gulf sturgeon, Nassau grouper, oceanic whitetip shark, smalltooth sawfish, shortnose sturgeon, elkhorn coral, staghorn coral, boulder star coral, lobed star coral, mountainous star coral, pillar star coral, and rough cactus coral are excluded from this summary table as they were discounted from further analysis in Section 4.9.1.
[2] Critical habitats of these species that occurred within the Action Area (NARW, loggerhead sea turtle, Atlantic sturgeon, Gulf sturgeon, Nassau grouper, smalltooth sawfish, elkhorn coral, staghorn coral) are excluded from this summary as the Proposed Action was determined to have **"no effect"** on any of the physical and biological features of these habitats. Other critical habitats do not occur within the Action Area.
BD = behavioral disturbance from noise; LAA = likely to adversely affect; NLAA = not likely to adversely affect; Not applicable = not part of the Proposed Action; PTS = permanent threshold shift / auditory injury

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